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The Evils of Indiscriminate Competition.

ALTHOUGH the problem of foreign competition has been discussed and re-discussed, both in the trade journals and the political press, until there is danger that further discussion, far from acting as a stimulus, will provoke a state of apathy, there is one point which has scarcely been touched upon as yet, and which is of paramount importance—namely, our duty of discriminating between the channels into which to direct our energy and of refraining from wasting our power in efforts that may be recognised beforehand as hopeless. There are natural limits to all enterprise, and unless we take into account these limits we will deserve the failure that might have easily been foreseen. All success or failure depends upon two main factors—namely, the circumstances or conditions in which we find ourselves on starting, and those arising during the progress of action. The former comprise our physical and mental qualifications, our position, our family, our reputation, etc.; the latter include all the obstacles and advantages which we meet in pursuing our aim, and which were unknown to us at the time we began our task. These circumstances or conditions are "data"—*i.e.* "given" facts—strictly limiting what appears under the aspect of so-called voluntary action. Ignoring for the moment altogether the weary and futile controversy between those who assume the existence of a "free will" (in the non-scientific sense) and those who uphold the theory of determinism, the existence of these limiting "data," absolutely controlling even the so-called voluntary activity of man, whether regarded as the acts of single individuals or the compound activity of a tribe, race, or nation, remains a stubborn and uncontroverted fact. This being so, it is obvious that if we wish to proceed rationally in our life in all we do, we should ascertain beforehand, if possible, the character of these determining data, and select our course accordingly. Those data that constitute our condition on starting are to a great extent, or at least can be, known to us. Those that will arise in the course of the progress of our enterprise lie totally beyond our ken, except in so far as the chances of their being favourable or unfavourable for our project may be calculated on the basis of the theory of probability. Under these circumstances it is obvious that, though we cannot foretell absolutely the outcome of our venture, we are in a position to distinguish between a route that, so far as we can see, must absolutely lead to failure and one that is more likely than any other to lead to success. Within the limits of this possible knowledge alone rests our responsibility, and others will judge our failure or success by taking into consideration the determining and limiting data beyond our control and what we knew of all that we might have known when setting out upon our course of action. Making a practical application of the above-stated truth in considering how and when we can hope for success in competition with other nations, we find that among the "data" determining our present circumstances there are in our favour those national characteristics that more than once have led us to victory: the energy, the perseverance, the keen sense of honour and probity of the British race, together with its equanimity under adverse circumstances, and the firm resolution to succeed which increases rather than is weakened by reverses. Against us are the shortcomings of our character, such as the stubbornness into which a portion of our energy and perseverance has degenerated

—for but a hair's breadth divides virtue from vice—our reluctance to acknowledge the superiority of our enemies even when it exists, and to learn from others or to adopt their methods; and, finally, our lack of elasticity which prevents us from adapting ourselves to changed conditions, the importance of which our self-sufficiency often prevents us from acknowledging. For us, again, are the glories of our history, whose memory acts as a powerful stimulus upon all of us, and endows us with courage and confidence in the future; for us also are our position in the very front rank of civilised nations and our extensive possessions, for there is a deep truth in the saying "*beati possidentes.*" As regards our great wealth, it must be counted as a *datum* that may be of immense benefit to us, or become a terrible curse. Which of the two effects it will exercise will depend upon the use that the nation makes of it. Against us are our comparative isolation, due, to some extent, to our insular exclusiveness and lack of affability, but more so to the jealousy caused by our worldly success in the minds of those that are less successful. Also against us, and especially so in connection with our isolation and lack of friends, is the fact that for our food-supply we have to rely upon imported products, a dangerous circumstance in case of a great war, and, if we trust the view of naval and military experts, our unpreparedness as regards our army and our fleet. Taking into consideration, however, all the factors above mentioned, there is a great balance of data in our favour, and, under normal conditions, we need fear neither a foe in war nor an antagonist in industrial and commercial competition. In fact, we have all that is required to let us look with equanimity into the future, provided that we proceed rationally in all our undertakings. This proviso, however, implies that we should realise that at the present moment the economical conditions of the world are no longer those that heretofore have determined Great Britain's industrial and commercial supremacy in nearly every direction. Other nations, such for instance as the inhabitants of the United States and the Germans, whose activity until a comparatively recent period was almost entirely consumed in the management of their domestic affairs, have, by the natural course of evolution, entered the wider arena of international competition in the production of manufactured goods, the sale of them in the various markets of the world, and the acquisition of a merchant fleet for their transport and that of the raw materials required in their manufactures. This, naturally, necessitated also the creation of navies on their part in order to protect their merchant fleet, and we thus find that our future progress in industry and commerce for which at one time there appeared to be practically no limits, will in future be confined within strict boundaries, erected by the interests of our new competitors, who severally will limit, not only our own, but each other's sphere of paramount influence. Each of them will try for the best place in one or the other line of industry and trade, and the chief determining factor in the contest for the supremacy in the various fields of industrial and commercial activity will have to be looked for in the distribution of the natural resources and raw materials, and the conditions that render these materials more or less accessible. As regards these, our position is, for the present, far from favourable, and in many directions we perceive rivals who have a better start in the impending contest. Metals and minerals, notably coal and iron, have been discovered in abundance in the territories owned by them; fibre and timber and many of the more important raw products for the worlds' industries are present in their soil and absent from our own, though, fortunately, not from that of our great colonies, whose loyalty will become a factor in Great Britain's future, more important perhaps than any other. Climate, sea-board, water-power, and other elements of great weight in the development of industries are also distributed in such a manner that, were it not for our extra-European possessions, we would find ourselves seriously handicapped. These and other data should be carefully weighed ere we concentrate our energy upon some definite course of action, and all discussions of

the problem of foreign competition are wasted words, unless we bear the above aspect of the problem constantly in mind. Whatever efforts we may determine upon for the future, either with the object of regaining what we have lost or acquiring what we need, a frank recognition that in some directions there are absolute barriers to our enterprise, is our duty, and it is equally our duty to determine our course by avoiding these, and by selecting that route where the chances are in our favour. Indiscriminate competition is a serious mistake, as it must lead to a great waste of energy in undertakings, the failure of which is not only predestined, but could have been foretold, had the determining factors been ascertained before starting. That we have no longer a monopoly in the industries and commerce of the world is a patent truth. It is equally patent, however, that no other nation will have it. Each of the competing countries will find in time her natural level, and those who recognise this level beforehand will first arrive at their aim. With the growing complexity of human conditions, specialisation is the only rational course to be adopted. In order to specialise, however, it is necessary to make a careful survey of the whole area of possible enterprise. We should devote a good share of our time for the present, therefore, to this preliminary but absolutely necessary activity, which, though apparently unproductive, will be found in the end to have been most fruitful in valuable results.

Board of Trade Electric Lighting Regulations.

An inquiry of considerable interest, and extending over the greater part of March, has been held by the Board of Trade, to consider the position of consumers entitled to object to the change-over of electric supply from 100 to 200 volts, or upwards to the maximum limit of 250 volts.

The inquiry was held on the application of the Westminster Electric Supply Corporation, who were supported by between 60 and 70 Supply Companies and Local Authorities, for an alteration of the following proviso of the regulations which have been made by the Board of Trade for ensuring a proper and sufficient supply of electrical energy, viz. :—"Provided that no change shall be made in the supply to any premises which at the date of these regulations are supplied with energy by the undertakers, except with the consent of the consumer."

The alteration applied for was that, for the words "with the consent of the consumer," there should be substituted the words "on such terms and conditions as may be agreed upon between the undertakers and the consumer, or, failing agreement, as may be settled by an arbitrator appointed by the Board of Trade," or words to that effect.

The inquiry was presided over by Sir Courtenay Boyle, the permanent secretary. In addition to the Companies more immediately interested, and some of the objecting consumers, the City of London Corporation and the London County Council were represented by counsel in the interest of the general public.

The decision of the Board of Trade has not yet been given, and some legal questions were raised as to their power to make such an alteration, so it may be some time before the matter can be finally settled.

The general consensus of opinion was, however, decidedly to the effect that a small number of consumers should not be entitled to put a company to the expense of continuing a special supply for their benefit, or in the alternative to obtain any terms which they choose to ask for. On the other hand it was generally agreed that the consumer ought to be indemnified for any expense to which he might be put through the carrying out of the change.

This is surely the common-sense point of view. There can be no question that the adoption of the higher voltage is desirable, as it lowers the cost of electric supply, and the special pleading of some of the experts entirely failed to show that the time is not ripe for its adoption. This being so, it cannot be tolerated that a few

objectors should be entitled to use the Board of Trade regulations in order to extort undue advantage to themselves. On the other hand, the consumer must necessarily be put to expense in effecting the change over, as besides obtaining new lamps he must have his whole system of wiring overhauled, and, if only just passable for the lower pressure, it will be necessary to rewire. He would also have to change most of the switches and possibly some other fittings.

It was shown in the course of the inquiry that, while some of the companies took the fair course of compensating the consumer for the expense he was put to, and allowing him to share in the benefits of the new system, others had behaved in a very different manner, and even brought quite illegal compulsion to bear, trusting apparently to the ignorance of the consumer, or possibly to his probable unwillingness to enter into litigation with a company or local authority with extensive resources.

There was a certain amount of expert special pleading as opposed to evidence on both sides, but most notably on the part of the opposition.

Professor Ayrton, for example, brought forward a series of phenomenally bad results obtained in testing some 200-volt. lamps, and succeeded in making a decided score against the Westminster Company when he stated that some of these were lamps of the same kind as the Company had supplied to offices in Victoria Street.

Plenty of evidence was, however, brought forward of the existence of good 200-volt. lamps, and no one doubts that there are plenty of bad ones as well. Col. Crompton who appeared in support of the application, thought the consumer was more likely to get good 200-volt. lamps than 100-volt. ones, simply because the makers of cheap rubbish who flood the market with their 100-volt. lamps have not yet taken up the manufacture of the 200-volt. ones.

The facts with regard to these lamps are, we believe, that 200-volt lamps are to be obtained, even of comparatively low candle-power, which are in every respect equal to the best 100-volt lamps.

On the other hand, the recent sudden and large demand for the higher voltage lamps has induced a number of makers of experience and repute as regards the lower voltage lamps, to take up the manufacture of the higher voltage ones, in which they have not yet gained experience.

It is admitted on all hands that the increase in voltage will make it easier to keep the variation of pressure within the Board of Trade limits of 4 per cent. which is certainly not done at present. If the companies would do this then the consumer would benefit greatly, as it would become possible to economically employ lamps of the highest efficiency, which cannot be done on the public circuits at present, even when the higher voltage is in use.

This point of maintaining a steady pressure is not insisted upon as it should be. Government gas inspectors make daily tests except on Sundays, and the companies are fined when the illuminating power falls below the minimum allowed. On Sundays, there being no tests made, it is generally believed by those who are supposed to know that a larger proportion of low-grade gas is worked off.

Why should not the pressure on the electric light companies' mains be subject to similar tests with like penalties? The consumer grumbles when his lamps show dull through the pressure falling, or when they break down too soon from excess of pressure, though in the latter case the maker generally comes in for the blame. Even when the consumers know exactly what is happening they have no remedy unless they put a voltmeter across the circuit and record its readings; and though this has been done, it is not often that even electrical engineers will take the trouble. Another point which the opposition attempted to raise was, that when the three-wire system was employed, and the three wires were brought into the same building, circumstances might occur under which a 400-volt shock might be given.

Professor Ayrton suggested that this might happen if one of the outers came in contact with a stair-rail, or electric-bell wire or other conductor which was fairly

well insulated from the ground. We presume it would also be necessary, before such a shock could be received, for the other outer and the stair-rail to be simultaneously in contact with the body, but this was not pointed out.

Dr. Jekyll and Mr. Hyde in the Editor's Chair.

In comparing the editor of a greatly-esteemed contemporary to the two widely-differing components of the compound personality of the hero of this once favourite tale we must begin by disclaiming the smallest intention of tracing out any further resemblance than lies in the analysis of a single personality into two most distinct and opposite-thinking portions.

In the editorial columns of *The Electrical Review* of April 12th we find the following article:—

"In the April number of FEILDEN'S MAGAZINE there is a short editorial on the Kennedy conduit. This article confirms our previous criticism upon the small amount of practical knowledge shown by most of the writers upon the subject. The article in question caps the climax for absurdity.

"For instance, the writer says: 'The Kennedy conduit differs radically from the commonly accepted type in that, as should be evident to any engineer familiar with electric tramway work, it has been designed to meet entirely different conditions.' The slur upon the intelligence of even 'any engineer' would have been more effective if these 'entirely different conditions' had been mentioned. Most engineers familiar with the subject had supposed that if the conditions in London differed from those in other cities, it was only that they were more severe, and that, therefore, extra precautions would be necessary to ensure success. Apparently, in the opinion of the writer of the article, this is not so.

"He defends the light weak yokes of the Kennedy conduit for the reason that they were designed for the 'good solid roads' of London. That the up-town conduits in New York were blasted out of solid rock seems to have escaped the knowledge of the writer. If these are not solid roads we should like a definition of the expression.

"It is true that there is no necessity whatever for carrying the track rails upon extensions of the yokes; but it does not follow that strong yokes are uncalled for. On the contrary, we venture the assertion that if there is a city in the world where strong unyielding yokes are needed it is this city of London. We are informed by experienced engineers that if the Kennedy conduit should be subjected to the strains due to frost, it would be impossible to insert the blade of a penknife in the slot.

"We will refer to one other statement in this article. The writer states that the carrying of the insulators by the yokes is an 'additional burden' to these, and will involve a heavier form of yoke. A yoke has to support the greatest loads that can be put on it by the street traffic. It must at least support the heaviest load carried on one wheel of a waggon. If the paving were even slightly below the level of the slot rail this load would be in the form of impact, and the yoke would have to stand the shock of such. The conductor rail weighs approximately 25 lbs. per yard, and with a yoke spacing of 5 ft. each yoke would have to support the 'additional burden' of, say, 100 lbs. We should like to see the calculation showing the extra amount of iron used in the yoke for this 'additional burden.'

"Really, if 'militantly British' magazines publish such leaders as this on the subject, they may lay themselves open to the ridicule of American and Continental engineers, who have at least an elementary knowledge of the subject."

So far Mr. Hyde. For Dr. Jekyll's contribution we turn to the editorial columns of the same Journal of Feb. 23rd, where we find:—

"In the original New York lines, a rigid construction was absolutely indispensable, owing to the then unsettled and defective state of the roadway. Conduits in other towns were conducted on the same lines, in some cases for precisely similar reasons, in others by force of example. But is this really necessary in London? Where else can be found such excellent roads, based on the soundest foundations, and efficiently drained? Moreover, what experience has already been acquired in conduit practice under such conditions? The answer, obviously, is to be sought in cable conduit practice. One of our figures shows the system adopted both at Edinburgh, and, very aptly, at Brixton, where it has been running for years. It will be seen that the L.C.C. yoke is of very similar type to those used for the the cable tramways . . . ."

Evidently Mr. Hyde has quite forgotten the thoroughly reasonable comments which he made as Dr. Jekyll, or he would have seen that the first half of his article had been answered beforehand.

Mr. Hyde's assumption that if the conductors were supported in the usual way by means of insulators attached to the yokes the additional stresses would be only those due to the dead weight of the conductor rails is really too absurd for serious discussion. Perhaps Dr. Jekyll

may think well to devote a little space in a later issue of our contemporary to a little elementary instruction adapted to the needs of Mr. Hyde.

The Water-tube Boiler Committee.

THE recommendation of the Committee that experiments should be carried out with the Dürr, Yarrow, Niclausse, and Babcock-Wilcox boilers, with a view to obtaining results of their action, has been adversely criticised from the point of view of unnecessary expense. The severe strictures passed upon this portion of the Report of the Committee by one expert, who was quoted in FEILDEN'S MAGAZINE last month, went directly to the root of this matter, but much more might be said upon the subject. It is, at any rate, evident that the opinion which we published is a justification of the attitude of those who have all along maintained that the constitution of this Committee is defective in that none of its members, except the one who is committed to the defence of past naval practice, possesses expert or practical acquaintance with water-tube boilers. In this fact is no doubt to be found the explanation for the special recommendation to which attention is here directed. Nothing can be more natural than that those who have not studied the question of the various water-tube boilers should be glad to avail themselves of the opportunity of acquiring practical experience of the performance of some of them at the expense of the country. No doubt they wish to obtain this information so that it may be recorded in an official form, but if some of the individual members of the Committee were already in possession of existing records of trials of the boilers mentioned, and were in a position to sift them, a report could at once be framed which would convey at any rate some of the same information as that which the present members expect to derive from fresh trials.

Another and a much larger question is opened up by a consideration of the water-tube boiler episode. It is not merely a matter of importance to know who is to blame for what has happened in the past, but there is the question of whether it is not possible to introduce some safeguard against such blunders happening at some future time. It cannot be supposed that we are at an end of change and improvement in things naval and mechanical, and therefore it is certain that as time runs on new designs and devices will at different periods come to the front, and the propriety of their adoption will have to be decided upon. Why should there not be some permanent machinery for this work, such as a committee on designs, embracing amongst its members some engineering experts in civil practice, the benefit of whose advice and assistance would be thus available at all times for the good of the country? No sensible person imagines that the Services cannot profit by advice and assistance from the "outside," but if official exclusivism and red-tape are founded upon the opposite view it is so much the worse for the Services. If they are, this would explain why such blunders are likely to happen; but before such an attitude could be tolerated, official jealousy would require to assimilate the weighty (though perhaps unpleasant) fact that most, if not all, of the improvements or steps in advancement which are adopted have their origin not in the Services, but are brought into them from "outside."

Were a proper permanent committee on designs in existence charged (like the Bureau of Steam Engineering of the U.S. Navy) to issue a yearly Report to the nation on progress and its bearing on the increased efficiency of the department, the Service or the country could not at the worst drift into such an abyss of muddle as is plainly possible under our present system.

The present state of the engineering department of the Navy, as well as that of questions of individual appliances, such as water-tube boilers, is enough to show that "outside" expert assistance never was more wanted, and that the miserable pride of officialism, which has striven for many years to exclude that assistance, spells pretty accurately miserable failure.

"We are, in the vastness of our possessions, losing our grip on national sentiment. It is our duty to maintain intact, and to defend by sea and land, all that our empire builders have left us. The day that sees the defence of the British Empire sapped, sees the disintegration of the Nation's trade and the hands of civilisation's timepiece put back 200 years."—RT. HON. LORD CHARLES BERESFORD, C.B.

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Wage-Earners in the United States . . .

MUCH has been written of late regarding the high qualities of the American workman, but little has been said as regards his earnings, and though it is generally admitted that wages are higher in America than in Europe, few persons seem to know how much higher they are, while it is very frequently stated that the difference between the incomes of American and European wage-earners is practically equalised by the cost of living. This latter statement, however, is absolutely erroneous. Food, on the whole, is much cheaper in America than in Europe, which is natural enough in a country producing considerably more food than is required by the population, and having an area of such enormous dimensions that even low freight rates to markets where these food products are required are frequently twice and even three times as high as the intrinsic value in the producing localities. Clothing and rent have in recent years considerably decreased in cost, and are but slightly higher than in Europe, and the only articles that cost considerably more than among us are luxuries such as spirits, wines, tobacco, cigars, etc. These facts can be easily verified by consulting any reference library, and it is strange that so much misapprehension exists among us regarding them. Taking matters, however, as they are, the figures given below will be quite a revelation to many, and especially to those who still believe in the fiction of the miserable condition of the working classes throughout the world. Compared with the average income of the many thousands of young men who are endeavouring to make both ends meet in the so-called "liberal professions," that of the American workman is quite princely. At the top of the list still remains the "glass blower." The wages of the "double-thick window glass blower" range from 175 dols. to 400 dols. per month; those of "single-strength blowers" are much lower; even none of these however earns less than 100 dols. monthly. It has been suggested that these high wages are due to the fact that, so far, at least as regards the manufacture of window glass, the essential operations are still being carried on without the use of labour-saving machinery. This, however, is an erroneous assumption. The introduction of labour-saving machinery has been the cause of a different division of wages among the various classes of workmen, but not of a decrease of wages as such. On the contrary, the following will show that the very highest wages prevail in trades where mechanical devices have been the means of greatly increasing the output. The plutocrats in the American labour world are the men engaged in the iron and steel mills, and among them—owing to the increased tonnage of the modern mill—form, it is said, the upper circle, and get the highest pay. Rollers are paid by the ton, receiving 10 cents each per ton, and as the modern mills turn out 200 tons daily, each roller receives about 20 dols., *i.e.*, £4 per day—a snug little income for

one of the "oppressed" it will be granted. Sheet rollers are not quite so highly paid, but in some cases, in mills where no time limit is enforced, individual rollers manage to earn an annual income of 12,000 dols. According to Mr. J. E. McGrath, in the *American Manufacturer*, a roller at the Shoenberger plant, before its consolidation, resigned rather than accept the offer of 4,000 dols. per year for himself and 3,000 dols. for his assistant, as a fixed annual income, for the very sufficient reason that for many years his wages had never been less than 8,000 dols. per annum, and that he felt certain of earning the same amount in any other mill. There are, of course, fluctuations in the incomes of these workmen, depending on the state of the market for the time being, but they are comparatively slight. According to reliable authority, a sheet mill roller, under the present scale of wages, earns about 13 dols. a day in the United States; and also the other men engaged in the mills earn an income that, with due economy, should render them independent in a very few years. Thus a doubler receives 8.50 dols., a heater 7.88 dols., and a catcher 3.80 dols. daily. The labourers in tin mills are not quite so well paid, but still the wages are very liberal. Rollers in these mills draw an average income of 15.30 dols., of which 3.50 dols. are deducted as wages for the catcher, 3.25 dols. for the rougher, and 30 cents. for the single boy, which reduces the roller's wages to 8.25 dols. These remunerations form a portion of the amount paid in wages for the average daily output of 5,740 lbs. of thirty gauze sheets in a six-mill plant. So also are earnings of the doubler, who receives 7.90 dols. per day, from which he pays the pair handler 1.50 dols. and the single boy 30 cents, which leaves 6.10 dols. for himself. Larger mills have an output of about 5 per cent. more, and the workmen's wages are increased at the same ratio. The British workman in the Welsh tin plate mills is far differently situated. The roller in these mills is paid an average 3*s.* 5*d.*—*i.e.* about 80 cents—per dozen boxes; while the doubler receives 2*s.* 10*d.*—*i.e.* 66 cents for the same output. According to the American rate of wages, the roller receives 3.22 dols. per dozen boxes—*i.e.* more than four times the amount of his British colleague; and the doubler's income would be 1.77 dols.—*i.e.* nearly three times that of the doubler in the Welsh mills. These figures clearly show that, notwithstanding the increased use of mechanical devices, or perhaps just in consequence of it, the workmen in the United States have little to complain of.

An Electric Express Train . . .

THE announcement that one of the most famous electrical engineering firms is about to build and equip an electric railway line between Berlin and Hamburg, on which trains are to run at a velocity of from 120 to 150 miles an hour, has been received with a sceptical smile on the part of the public at large in this country, and, even as regards the engineering profession, there has been a disposition not to take the matter *au sérieux*. Of course, it is quite right not to commit oneself with regard to a project of which reliable data are yet wanting upon which to form an opinion. Those, however, who believe that the objections recently raised against Mr. Behr's Liverpool-Manchester mono-rail scheme hold good also as regards the German project are entirely mistaken. In the first place, the Hamburg-Berlin railway is not to be a mono-rail enterprise, but a broad-gauge line of "special construction." What is hidden under this latter description we do not know; but to a broad-gauge scheme many of the criticisms of Mr. Behr's scheme do not apply. Moreover, the difference between the lengths of the tracks of the two lines invalidates the main objection raised against the Liverpool-Manchester line when applied to the German project. This main objection was, that Mr. Behr had not been able to show that it would be possible to stop trains running at so high a speed in time to prevent accidents, and the Parliamentary Committee doubted whether sufficient brake-power could be provided. It is true that the German trains are to run at a still higher speed

than that contemplated for the mono-rail trains of Mr. Behr, and, at a first glance, it seems that the objections mentioned would, on account of this very fact, hold good *a fortiori* as regards the Hamburg-Berlin scheme. This, however, is not so, for the following reason: — Since the Liverpool-Manchester line was to be only about 30 miles in length, the distance which would be covered by a train of such unusual speed from the moment of applying the brake to the moment at which a stand-still would be reached would represent an undue percentage of the total length, and an equal percentage would be represented by the length of line covered by it from the moment of starting to the first moment in which it would begin to travel at full velocity. Under these circumstances it would be necessary to provide both for acceleration and retardation an amount of power far in excess of that hitherto used for similar purposes. In a line of 150 miles, however, which is the distance from Hamburg to Berlin, the percentage represented by the portion of the track which the high-speed train would cover during acceleration and retardation would be much smaller, and an abnormal acceleration or brake-power would not be required. This, however, is only one of the points in which the two schemes differ, though we grant it is an essential point; but there are many others almost equally important and equally in favour of the German project. For these, if for no other reasons, it will be well to suspend judgment until the case has been more clearly stated. So much, however, may be said at once, namely, that the name of the German firm mentioned in connection with this Hamburg-Berlin project is in itself a guarantee that we have no wild-cat scheme to deal with.

Canadian Trade Returns . . .

THE trade returns for the fiscal year bring the welcome news that this has been a record year for Canada, since never before have the imports and exports of the Dominion reached the high-water mark indicated by the figures given below. The imports amounted to $189,622,513, this being an increase, as compared with the previous year, of $26,858,200; while the value of the exports was $191,894,723, representing an increase of $33,000,000. British imports to Canada amounted to $47,789,730, *i.e.* to $7,700,000 more than last year, while the Canadian exports represented a value of $97,000,000, *i.e.* nearly $8,000,000 more. The imports from the United States had a value of $93,000,000, and the exports to that country amounted to $54,000,000; the increase in the trade between the two countries being $25,000,000. The effect of the lower duties on British goods, which came into operation on July 1st, when the rebate was increased from 25 to 33⅓ per cent., was evident in the considerably decreased receipts during the last six months, as compared with those of the first half year, shown in the Customs returns for the port of Montreal, though they indicate a substantial increase for the past year on the Dominion's trade with Great Britain. Since the value of imports from countries enjoying the preferential tariff has been considerably more than a million of dollars during the last six months, the whole decrease in the receipts is due to this reduction in the duties. Recent information shows that both the volume and the value of imports into Canada continue at the high-water mark above given.

Prussia's New Waterways . . .

THE signs that Germany is steadily advancing in the direction of commercial progress are unmistakable. Her ambitious efforts and signal achievements in the shipbuilding industry in general, and her far-reaching projects as regards the construction of war vessels to supply her own requirements and, if possible, those of other countries, have been discussed already in these columns; and the important extension and re-construction of her waterways for inland navigation, which is to take place in the very near future, shows that not only is it her desire to

become a leading commercial power, but that her commerce has reached already a height for which her former system of traffic distribution no longer suffices. The King of Prussia in his position of German Emperor—not Emperor of Germany, as must be borne in mind—is naturally anxious to strengthen the undisputed political hegemony of his kingdom in the Empire by securing for it also the absolute industrial and commercial supremacy, and rendering its capital the centre of the whole national life of the German nation. With this aim in view, the Royal Prussian Government is taking the lead in the waterways extension scheme, and has formulated proposals which, though the details are not yet obtainable, have the obvious aim in view of making Berlin a sea port that is to rival or rather to excel the importance of Hamburg and Bremen, both of which are outside the limits of the kingdom. This project, although some years ago it would have been ridiculed as fantastic, is quite feasible with the improved methods of modern engineering, and of considerable interest for our own commerce. The main feature of it is to be a new canal from Stettin, the leading Prussian port, to Berlin. The two cities have been in water connection for a number of years by means of a small canal joining the Oder and the Havel rivers. The new canal, however, is to be of sufficient width to permit the passage of larger vessels. From the draft of the project, it appears that it is to be limited to ships of a carrying capacity of 600 tons, but it is probable that when the details of the bill come to be discussed it will be decided to give to the canal a width and depth sufficient to admit average-sized coasting vessels of about 1,200 tons. It may be mentioned incidentally that Hamburg is already in direct water connection with Berlin, by means of the Elbe and its tributaries, the Havel and Spree rivers, for barges of 300 tons. The new canal is estimated to cost about 42,000,000 marks (£2,100,000), and the interest is to be guaranteed by the towns and villages which will benefit by its traffic. It is of importance to remember that the river Oder has recently been sufficiently deepened to permit the largest Atlantic liners to reach Stettin and its new "free-port," near which are situated the works of the famous Vulcan shipbuilding yard, where the *Kaiser Wilhelm der Grösse* was built. The distance between Stettin and Berlin is about 140 kilometres.

The Board of Trade and the Institution of Electrical Engineers . . .

In the first week of March Sir Courtenay Boyle presided over a conference of representatives of the Institution of Electrical Engineers; of the electrical section of the London Chamber of Commerce; of local authorities and companies seeking Parliamentary powers for the supply of electricity; and of the London County Council, held for the purpose of discussing a proposal made by the Board of Trade for reducing the maximum charge of 8*d.* a unit for electrical energy, which the Board considered too high. In the ensuing discussion, Col. Crompton, on behalf of the Institution of Electrical Engineers, and Mr. R. P. Sellon, Chairman of the Electrical Section of the London Chamber of Commerce, expressed the opinion that the proposed reduction would have the effect of preventing the introduction of electrical supply in small country places and thinly populated districts. As a result of their representations, it was agreed that a 7*d.* maximum should be adopted in normal cases, to be reduced, if possible, to 6*d.* in very large populous places, and that in special cases cause might be shown for making it 8*d.* This is a noteworthy instance of a most satisfactory arrangement being arrived at through the authorities responsible for the control of electric light schemes having the opportunity of conferring with the representatives of the electrical industry. We should greatly like to see the same principle carried further, as it would do much to prevent the possibility of the repetition of such blunders as the Electric Lighting Acts, for example, which are so largely responsible for our backwardness

in electrical development, as compared with the United States, Germany, and Switzerland. In the latter country the Association Suisse des Électriciens acts in the closest relation with the Government in all matters affecting the electrical industry, the Government in all these matters acting practically on the advice of a standing committee of leading scientific, technical, and commercial representatives. How long will it be before something of the same kind is done here?

Reform of British Patent Law . . .

THE impression left upon our mind by a careful study of the Report of the Committee appointed to consider the working of our Patent Acts is to a large extent a favourable one, but we have some doubts as to the advisability of some of the proposals. Indeed, in our opinion the best suggestions, and the safest to act upon without altering the general tenour of our patent laws, are contained not in the findings of the Committee as a whole, but in the notes added by some individual members at the end of that Report. The introduction of an official search through British specifications for 50 years prior to the date of any application—an entirely different thing, be it noticed, from the search in vogue in America, Germany, and most foreign countries—may do much to prevent the abuse sometimes practised by persons not scrupulously honest, who take out worthless patents simply that they may mark their goods "patented," and so scare away timid persons; but we do not view with approval the increase of power of the Patent Office authorities. We thoroughly approve, however, of the alternative suggestion put forward by one of the members, that applicants who desire to pursue their application in spite of the list of anticipating patents put before them should be allowed to do so, but that the public should be protected by an intimation on the specification itself that that list can be had by anyone who wishes it, on payment of a small sum. We agree also with the chairman, that the omission of the inquiry whether an invention, forming the subject of an application, is "obviously old" is a mistake, as the extra trouble involved would be small and the gain might be considerable. The proposed statutory limitation of anticipations by letters patent in patent cases to specifications dated not more than 50 years earlier than the patent which is alleged to be anticipated might prove a hardship, as it is very probable that cases may arise, as they have done in the past, where serious anticipations more than 50 years older than the patent attacked are to be found. The committee has evidently devoted care and attention to the questions put before it, and we believe that, by a combination of the general proposals on which all the members are agreed with those appended by individual members, a satisfactory basis for beneficial legislation may be obtained.

Important Inventions in Weaving . . .

FROM the description given in this issue of our Magazine of the ingenious inventions of Mr. Otto Hallensleben, it would appear as if the shuttleless loom has finally been made a success, and as if manufacturers of carpets and other pile goods will be able in future to have the dyeing of the yarn done by a process that requires the aid of two assistants merely for performing the same amount and kind of work that formerly required the attendance of twenty-four assistants. Such is the verdict regarding the colouring and printing method given by Mr. James Wade, who brought an experience of 40 years to bear upon his inquiry into Mr. Hallensleben's claims, and, as an expert, must certainly have had the best opportunity of forming a correct judgment. We also have had an opportunity of inspecting the machinery used in Mr. Hallensleben's works at Lucerne, and frankly acknowledge that his dyeing process deeply impressed us by the ingenious way in which time and labour are economised in it, without apparently unfavourably affecting the character of the work. In fact, the new process seems rather to improve the character of the dyed goods, since the yarns are

not only thoroughly impregnated with the dye, but there is a clear and distinct separation between two neighbouring colours, and overlapping or running of colours is practically avoided.

As regards the shuttleless loom invented by Mr. Hallensleben, there can be no doubt that, in case it should fulfil all that is said of it, the wealthy syndicate that has bought Mr. Hallensleben's patents and thus given the clearest proof of their absolute confidence in the practical value of these patents, will be able to increase their wealth to a noticeable degree; for the invention of an efficient shuttleless loom has been the ambitious aim of many inventors. Mr. Hallensleben's device for dispensing with the shuttle has been thoroughly tested by Mr. Wade, and the result of this test has been the conviction, as his report shows, that the use of the shuttle has had its day, and that this new device will be adopted for all kinds of looms and thus be used even by those manufacturers who will not introduce into their works the whole new process of weaving. This is of considerable importance, for Mr. Wade, who spent a considerable time in the inspection of Mr. Hallensleben's loom, must have had an opportunity of judging whether or not the device works without breakdown, and whether the picking up of the weft is regular and reliable. A mere casual glance at the apparatus, or even a superficial examination, such, for instance, as can be made during a flying visit, will not suffice to settle this point. Since, however, it is a crucial point—for the strength of a chain is only that of its weakest link—and since the efficiency of the apparatus is strictly dependent upon the efficiency of mechanism that does the work of the shuttle, we are glad to learn that Mr. Wade's inspection resulted in his conviction that the abandonment of the shuttle is a complete success, and we have no doubt that in that case we are face to face with a revolution in the weaving industry.

American Motor Cars for London . . .

THE motor-car industry is a thing that very few people understand. The "man in the street" sees occasional horseless vehicles, but not nearly so many as he was led to believe would be seen. Electric cabs seem to have died a natural death, and motor omnibuses hardly seem to have been born. Several energetic journals are devoted to the industry, but they are obliged to occupy a large portion of their columns with news from other countries Nearly all British makers of automobile vehicles appear to be too busy to execute orders, and foreign manufacturers are consequently enjoying a very pleasant time. The latest indication of the penalty we have to pay for backwardness is to be found in the establishment of a company whose object is to introduce American-made motor-cars for use in the streets of London. This company, which we are happy to say is largely, if not entirely, of British origin, proposes to provide buildings in various parts of the city and suburbs where electric cars may be hired, stored, cleaned, repaired, and recharged. The first of these establishments is already nearly ready for operation, and would have been completed months ago but for vexatious delays on the part of the ground landlords. It consists of a six-storey building in the West-End, all the floors being rendered equally available for use by the addition of an electric lift. It was the wish of the company to buy the lift in this country, but as no British lift maker could promise delivery in less than three months, the apparatus had to be procured from the United States, whence it was shipped within fourteen days from the receipt of order. A large number of motors have also arrived, and most of them are now fitted together ready for use. The electrical engineer in charge of the depôt is an American; he is very sanguine as to the success of the venture, and was at first rather inclined to wonder why English people had not already started something of the kind. We believe the last-named feeling is now beginning to wear away, because, after some months spent in the discussion of various legal, municipal, structural, and other objections, the nature of the hindrances offered in this country to any new and strange thing has been more fully realised.

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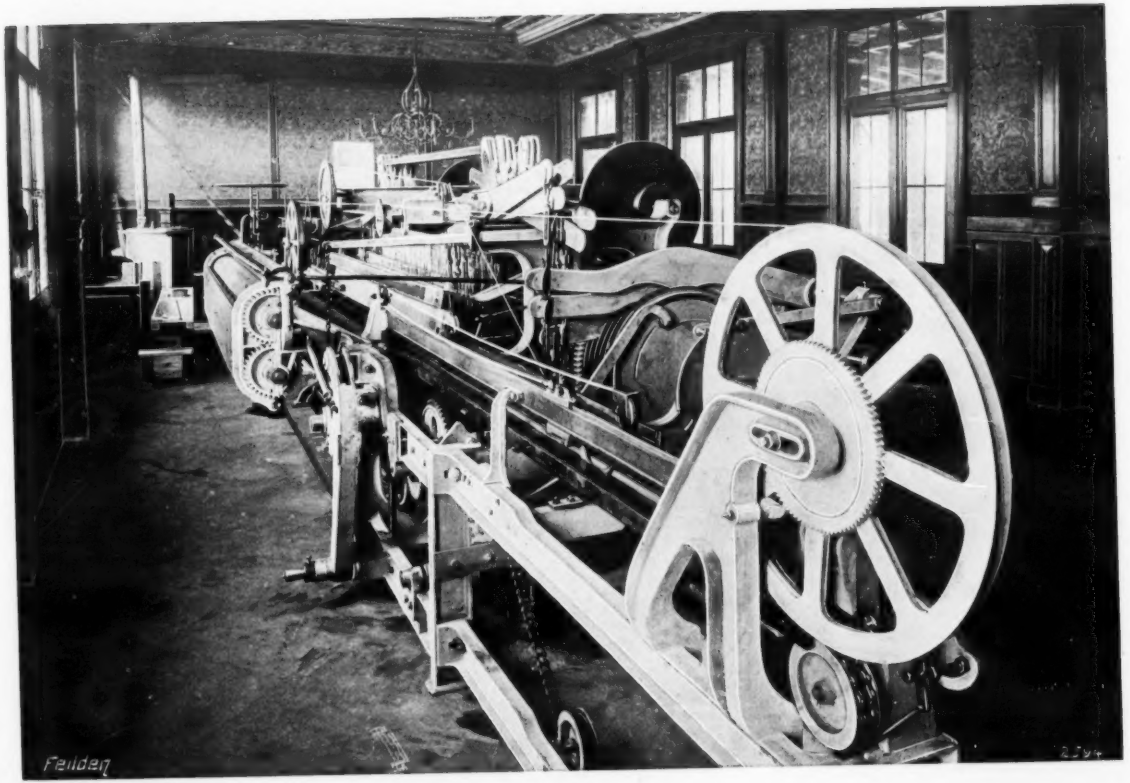
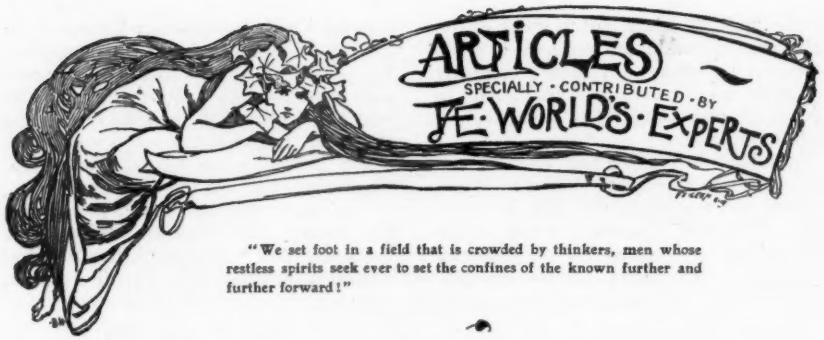


SHUTTLELESS DOUBLE PILE CARPET AND TAPESTRY LOOM.
DESIGNED BY OTTO HALLENSLEBEN.

FOR DESCRIPTION SEE PAGE 580.

For Description see Page 580.



"We set foot in a field that is crowded by thinkers, men whose restless spirits seek ever to set the confines of the known further and further forward!"

Electric Traction as applied to Cabs in Paris.

By H. E. P. COTTRELL, Assoc.M.Inst.C.E.
(Fellow of the Royal Colonial Institute, etc.)

MR. COTTRELL began his professional career when, in 1871, he entered the service of Messrs. Wilkinson & Smith, the once well-known Civil Engineers, as articled pupil.

Since that time he has been very actively engaged in a variety of useful and important works, acting as resident engineer on railway works in different parts of England, preparing plans for railways, tramways, and waterworks, both at home and in Cape Colony, constructing gasworks in Italy, etc., etc.

Mr. Cottrell has been engaged upon important works in British Honduras, China, Central America, Syria, and the Levant, and during the Brussels Exhibition of 1897 held the important position of Chief Executive Officer to the British Commission.

In recognition of the valuable services which Mr. Cottrell rendered to the management of this Exhibition, the Belgian Government appointed him a Chevalier of the Order of Leopold.

At the Paris Exhibition of last year Mr. Cottrell was engaged in the erection of the British Royal Pavilion.

As electrical matters go, this application of electric traction, at least in the tentative stage, is comparatively old in Paris, dating as far back as 1894. The great cab company of Paris, the "Compagnie Generale des Voitures à Paris," has for many years been casting about for some practical method of replacing horse traction, which seriously hampers their dividend-earning powers at all times, and often paralyses it altogether.

The difficulty of obtaining a sufficient supply of suitable horses, their liability to diseases of an epidemic character,* and the low average working life of the Parisian cab-horse (about $2\frac{1}{2}$ years) in the hands

* 2,392 of the Company's horses died of glanders alone in 1896, costing £68,110.

of the Parisian cabby, not to speak of the provender question, are collectively quite sufficient to induce any public company of their importance to experiment in directions promising relief from such a palorus situation.

M. Bixio, their managing director, was the first to appreciate the advantages offered by electricity, and had a cab of the "Mylord" type constructed in the year above mentioned for experimental purposes. M. Sarcia of the Société compared with the ordinary horse cab, to confirm M. Bixio in his original opinion. The excellent results obtained on tramways were a further confirmation, and he began to dream of the possibility of doing away with stables in the interior of Paris, where ground is so valuable, and their transference beyond the ramparts.

The next step was taken in 1897, when the Livery Cab Company (Compagnie Française des Voitures Electro-Mobiles) imported four specimen cabs from London,

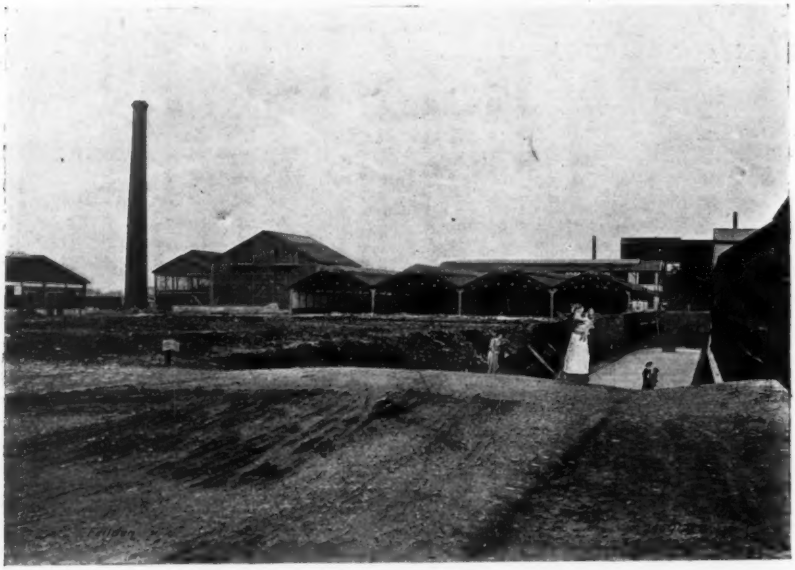


FIG. 1.—GENERAL VIEW OF GENERATING STATION, WITH ELECTRIC CAB SHEDS AND EXPERIMENTAL TRACK. FROM *O*. (*See plan.*)

Electrique des Métaux designed the motor and accumulators (disc type) with which it was fitted, and both worked satisfactorily, but the vehicle itself looked so clumsy to the critical eye of the Parisians that it was laughed off the streets, and is now preserved as an interesting relic at the cab depôt, Rue du Curial. Enough was, however, learned from this experiment to prove the superior cleanliness, compactness and handiness of the electric cab, as where some 35 were at that time running. These were a brougham, a small landau, and two small victorias, and these types, with insignificant changes, are the adopted types to this day for cab purposes.

One of the imported victorias took part in the Public Cab Competition, June, 1898, and the report thereon made by Mr. G. Forestier, of the Ponts et Chaussées and the Automobile Club of France, which specially brought out the peculiar merits

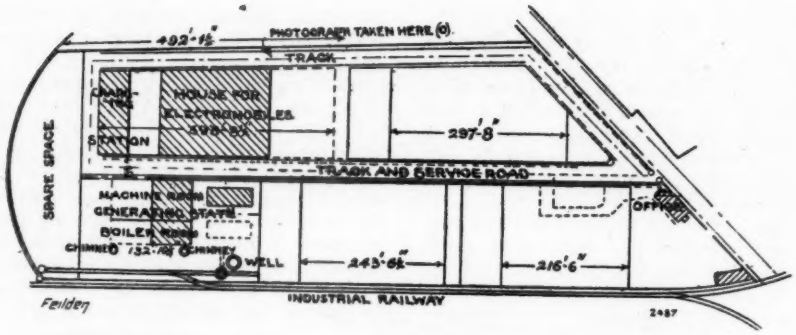


FIG. 2.—GENERAL PLAN OF GENERATING STATION AT AUBERVILLIERS.

of electric motors, as compared with petroleum motors for use in town streets, finally decided the General Cab Company (Compagnie Generale des Voitures à Paris) to adopt the electric cab on a large scale. £400,000 additional capital was raised for the purpose, land was secured for 25 years, with option of purchase, in the north-eastern suburb of Aubervilliers, about five miles from the Grand Opera and 40,000 square mètres in extent, for a central generating and charging station and carriage depôt. A hundred cabs were ordered to be built at once, and the equipment for the station at Aubervilliers, consisting of two horizontal 250-h.p. engines, driving by belting two generators of 1,250 ampère capacity at 120 volts, to deliver the current at 159 charging points distributed over three charging sheds. The buildings, including carriage sheds with accommodation for 250 cabs, were also put in hand, and an experimental track for the training of drivers was designed and built. A charging sub-station in the neighbourhood of the great boulevards at Rue Cardinet was also equipped, and about Easter of 1899 some 25 of these cabs were placed on the streets. The Company were not able to add to this number to any large extent during the subsequent six months because of the default made by manufacturers of the accumulators, who did not deliver these in accordance with their contract, and the remainder of the 120 cabs already completed were laid up in the sheds, the Company being at the end of 1899 still unable to use them. In 1900, however, substantial progress had been made to meet the requirements of the period of the Great Exhibition.

The type of cab finally adopted by the Cab Company was the subject of careful consideration. The first proposal was to substitute a motor truck with one or two wheels for the horse, and place it in front of the cab; this was the idea which has

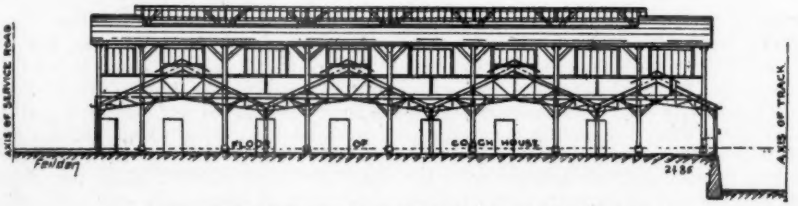


FIG. 3.—SECTIONAL ELEVATION OF CHARGING STATION AND CARRIAGE SHEDS.

eventuated in the development of the present front axle driving, of which many successful examples were to be seen at the Automobile Exhibitions of 1899 and 1900 in Paris. The second proposal was to have a single type of motor frame which could take closed or open vehicles equally well, exchangeable according to the season, and this was adopted.

The type of cab imported by the Livery Company, which we have seen about London for some years past, but modified so as to suit the second proposal, was adopted by the General Cab Company, as stated above, after the Public Cab Show of June, 1898, and the specifications for the cabs were made out in strict accordance therewith. This led to a curious result: the boxes for holding the accumulators were constructed of the exact size to hold 44 e.p.s. elements (Tommasi type of accumulators), and when these were condemned on account of their costly and unsatisfactory working record, it was found to be impossible to place more than 43 elements of the Julien type with Planté modifications in their place, and the cabs are working with this odd number of accumulators as a consequence. The question of accumulators is still the crucial question in the application of electric traction to automobiles; all accumulators so far are more or less defective from the point of view of weight, bulk, initial cost, and maintenance. The original Planté type, though fairly suitable for tramway work, where there is little variation in the rate of withdrawal of current, and where the permanent way subjects the accumulators to a minimum of shaking and shocks, do not at all suit vehicles working over the ever-varying, uneven surface of an ordinary street, or the abrupt changes of direction and speed required by an ordinary cab service. Their charging capacity is also too low for vehicles which have to cover at least the same distance as a horse (say 50 to 60 kilometres—32 to 37½ miles) would be expected to do without re-charging. A low cost of up-keep is also imperative as some set-off against the depreciation and wear and tear of rubber tyres which are indispensable to the life

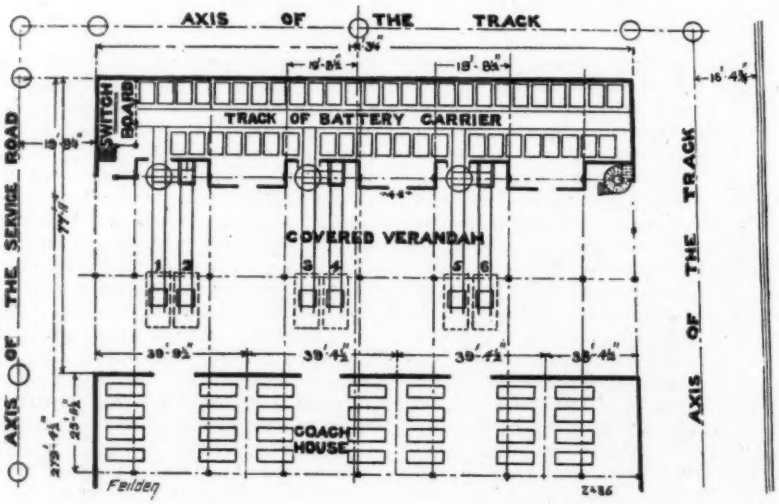


FIG. 4.—PLAN OF CHARGING STATION AND PART OF CARRIAGE SHEDS.

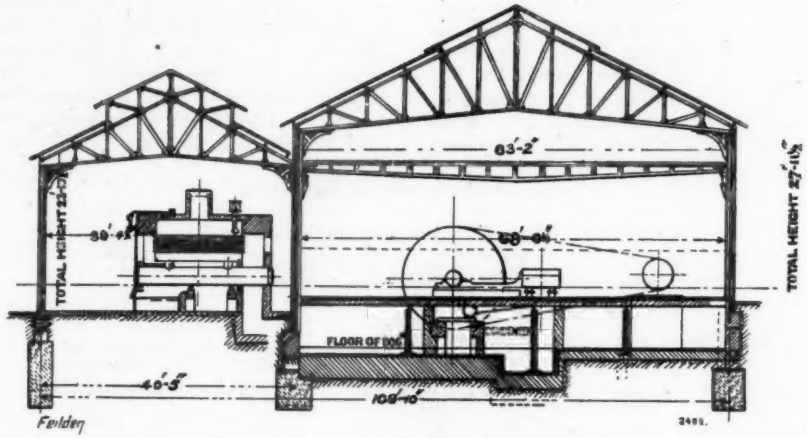


FIG. 5.—SECTION ACROSS DYNAMO AND ENGINE ROOM.

of both accumulators and motors, so that it was soon found impracticable to utilise the Planté type unmodified. The General Cab Company added the condition that the manufacturers should undertake the maintenance and repairs at a fixed and reasonable rate of all the accumulators they supplied. The choice lay so far between the accumulators supplied by the Société pour le Travail Electrique des Métaux and the Compagnie des Accumulateurs Electriques Blot. The latter, which are much in favour for electromobiles generally, are known as the Blot-Fulmen accumulator, with Planté positives and Fulmen negatives. They are guaranteed for 365 re-

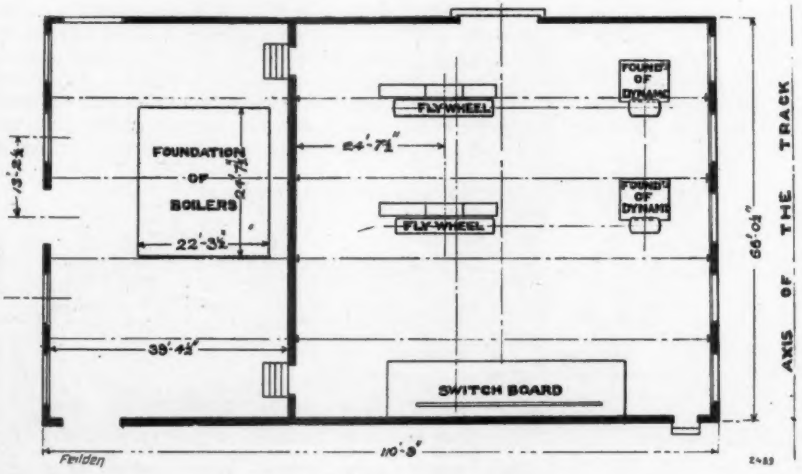


FIG. 6.—PLAN OF DYNAMO AND ENGINE ROOM.

charge as a minimum, with a minimum of 50 per cent. of the elements capable of standing further recharge if handled in a proper manner. The capacity of a battery of 43 of these accumulators in series, used in an ordinary electric cab, is from 60 to 70 kilometres ($37\frac{1}{2}$ to $43\frac{3}{4}$ miles) at 15 kilometres ($9\frac{1}{8}$ miles) an hour without being absolutely exhausted. All these accumulators being of the added oxyde type it is most essential to their length of life that they should not be at any time wholly exhausted in service, otherwise the plates suffer and the batteries cannot take the standard charge.

Table I., giving the capacity, weight, and dimensions of the various sizes in which these accumulators are made will be of interest.

The cabs themselves are outwardly of the English type, though the open landau and the victorias are an unfamiliar improvement on the improved electric growler to which we were accustomed in London. The power is applied to the hind wheels, the directing gear to the front axle, all four wheels taking pneumatic rubber tyres of a larger pattern than those on the obsolete London cabs. The cabs themselves are supported on a steel frame resting on the foretruck and the hind axle through intermediate flat elliptical springs (see Figs. 7, 8, 9, 10, and 11), no transverse springs being possible, because of the accumulator boxes. To secure these as much as possible from vibration and shocks, they are suspended from the frame through coiled springs acting in

TABLE I.—BLOT-FULMEN ACCUMULATORS.

Type.	Capacity in			Total Weight Kgs.	External dimensions.			Remarks.
	10 hours.	5 hours.	3 hours.		Length m/m.	Breadth m/m.	Height m/m.	
	amph.	amph.	amph.					
C. 11	125	115	100	13	125	140	320	$\frac{\text{Amph.}}{\text{h.}} = \{$ Average speed in kilometers.
,, 13	150	135	120	15·5	150	140	320	Size used for electric cabs.
,, 15	175	160	140	18	170	140	320	
,, 17	200	185	160	20	190	140	320	
,, 19	225	205	180	22·5	215	140	320	
,, 21	250	230	200	25	235	140	320	
,, 23	275	255	220	27	260	140	320	
,, 25	300	275	240	29·5	280	140	320	

NOTE.—The last two autumns the Automobile Club of France directed their attention to the Competitive testing of accumulators, and these tests, carried to the point of destruction, proved conclusively that no light weight accumulator could be seriously used, and that only one or two of the heavy weights could at all be depended on.

TABLE II.—DISTRIBUTION OF WEIGHT ON AXLES.

Nature of load.	Items.	Weights. Partials. lbs.	Partials. per cent.	Totals. lbs.	Totals. per cent.	Concentrated on Front Wheels. Idlers. lbs.	Front Wheels. Idlers. per cent.	Back Wheels. Drivers. lbs.	Back Wheels. Drivers. per cent.	Remarks.
Non-Paying	Carriage	2667·60	59·60		52·29					
	Driver	154·35	3·46		3·04					
	Accumulators	1653·42	36·94		32·37					
			100·00	4475·47	87·20	1543·23	30·30	2998·28	56·90	
Paying	4 Passengers			617·20	12·80	220·46	4·33	330·70	8·47	
			Totals	5092·67	100·00	1763·69	34·63	3328·98	65·37	The load on Idlers equals 52% of the load on Drivers.

compression. The whole arrangement of springs constitutes a double system of suspension, which safeguards the delicate accumulators from injury both in service and during removal for recharging and replacement when charged.

The following table (No. II.) gives the distribution of weight in these cabs when in working order under service conditions.

It will be noticed that the ratio of paying load to non-paying is as one to seven, and that the load on the idlers is as four to seven (nearly), both of which ratios are distinctly unfavourable; this is, however, unavoidable in the type of vehicle descended from the horse cab which has been adopted, and will no doubt be adhered to till the public taste is educated up to a

TABLE III.—DIMENSIONS OF CARRIAGE AND WHEELS.

Details.	Front Wheels.	Back Wheels.	Remarks.
Length of axle-box	6″·50	6″·70	
Average inside diameter of box (h)	1′′′·77	1″·97	
Diameter of wheels over tyres (w) ...	2′ 9″	3′ 7½″	
Ratio $\frac{h}{w}$	0·05	0·04	See figures No. 7, 8, 9, 10, and 11.
Gauge	3′ 8″	4′ 8½″	
Number of spokes	12	16	These are symmetrically and alternately inclined to each side of the central plane of the wheel.
Thickness of steel tyres	2″·75		
Do. rubber do.	2″·16		
Length of carriage over all	10′ 3″		
Width do. do.	5′ 10″		
Wheel base	7′ 5¼″		

FIG. 7.—FOUR WHEELER, WITH HIND-DRIVERS.

more suitable form by the evolution of the automobile of the future. The other dimensions of the cabs adopted in Paris, with further particulars, which are of interest as illustrating points in electric cab design in which our neighbours have departed from the standard type they adopted, are given in Table III.

The motors are of the Lundell-Johnson type, with four poles, excited in series, and two collectors; the winding is double, on both magnets and fields, so that by coupling the windings in series or in parallel different speeds can be obtained. By this arrangement two motors are linked into one, while their respective collectors are retained separate. The advantage of retaining separate collectors is apparent, as in case of the breakdown of one, the other will enable the cab to be taken to stable, although it is shorn of its intermediate speeds. The motors weigh 211½ lbs., and develop about 3½ h.p. at 1500 revolutions— which corresponds to a speed of ten miles an hour—they are manufactured by A. Postel Vinay, Paris.

NOTE.—The consumption of current from batteries is stated to be, by the Compagnie Française des Voitures Electro-Mobiles, 300 watt-hours per kilometre, or 2·8 ampères at 110 volts on an average, being equivalent to six 16-candle-power lamps burned one hour, and the average cost from 10 to 18 centimes per kilometre (1½*d.* to 2¾*d.* per mile) according to the type of accumulator used, inclusive cost of current, maintenance of batteries and carriage, etc.

The motor shafts carry a pinion having 22 teeth made of compressed raw hide held between steel cheeks, working a toothed wheel having 81 teeth affixed to the crown of the differential coupling. This arrangement, or, rather, the use of a raw hide pinion, diminishes to a great extent the rattle of the driving gearing and softens it down to the swish of a circular saw when cutting through a soft piece of timber of half the diameter of the saw. It is noticeable to anyone that the noise of the Paris electric cabs is far less

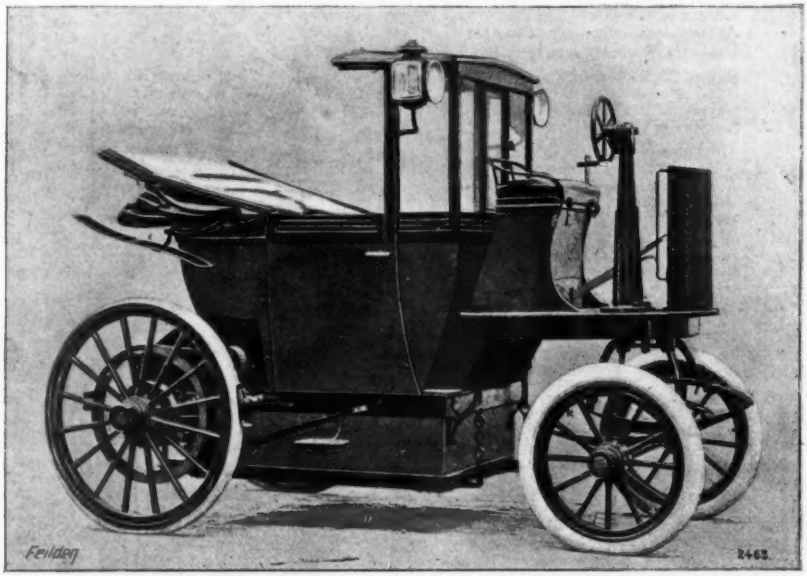


FIG. 8.—SMALL LANDAU, WITH HIND-DRIVERS.

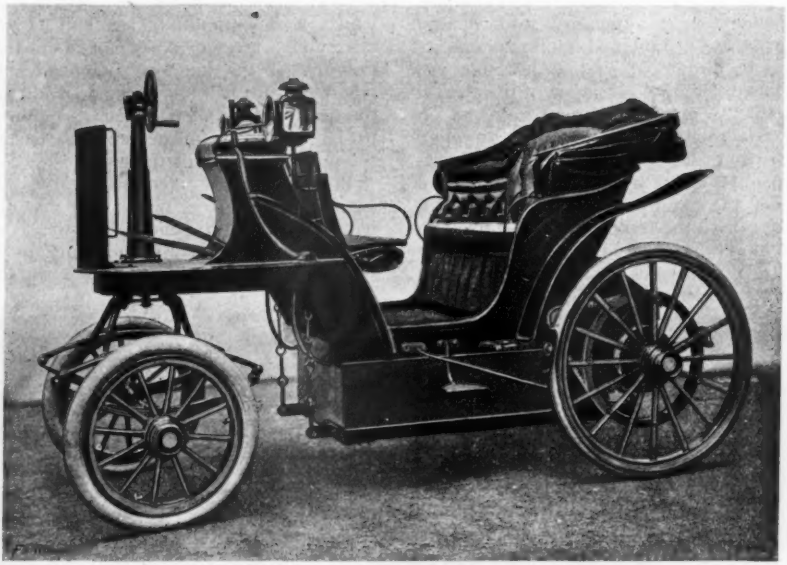


FIG. 9.—VICTORIA, WITH FRONT SEAT AND HIND-DRIVERS.

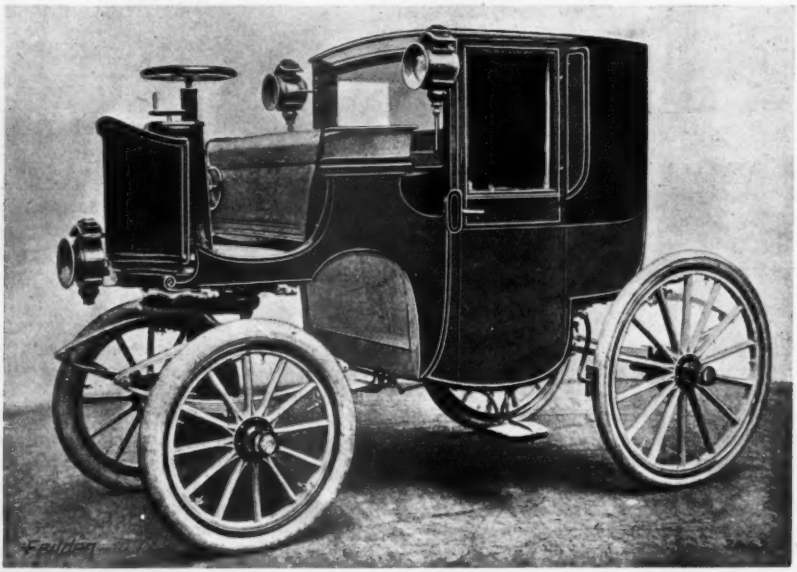


FIG. 10.—PRIVATE BROUGHAM, WITH FRONT-DRIVERS; ACCUMULATORS UNDER SEATS.
(PARISIAN LIVERY CAB COMPANY.)

objectionable in quantity and quality than that of their London compeers used to be.

The differential gearing is of the conical satellite type. Each pinion is keyed on an axle rotating in long bronze dowelled bearings provided with automatic lubrication. At either end of these axles are placed the chain pinions, having 19 teeth, which drive the toothed wheels affixed to the hind wheel-hubs of the cabs. These toothed wheels have 104 teeth. Both chain pinions and driving wheels are fitted with cheeks to prevent the chain from running off. These cheeks, in the case of the driving wheels, do not cover the bottom of the teeth, so that space is left for dirt and moisture to drop out. The driving chains are a variety of the "Reynolds" chain, known as the "Varietur" chain of the Sebin make. The advantages of this chain over its prototype seem to lie in the direction of diminution of noise, but the strips of which it is composed, ten and eleven alternately, are so close together that cleaning of the joints is practically impossible, and its efficiency depends on the quality of the metal, which is required to be practically inextensible to ensure the proper working of the teeth.

Both motor and differential gearing are supported by a steel plate; the distance between the chain pinions and the axles of the wheels is maintained constant in spite of the play on the springs in the following way. The plate supporting the motor and differential coupling is supported on a channel frame hinged on one side, attached to the prolongation of the axle bearings beyond the axle boxes and parallel to the rear bent axle, while on the front side it is attached by three compressed coiled springs, two of which support the motor and the other prevents it from jerking upwards on stopping. The driving chains are adjusted by two clamping screws. The weight of motor, differ-

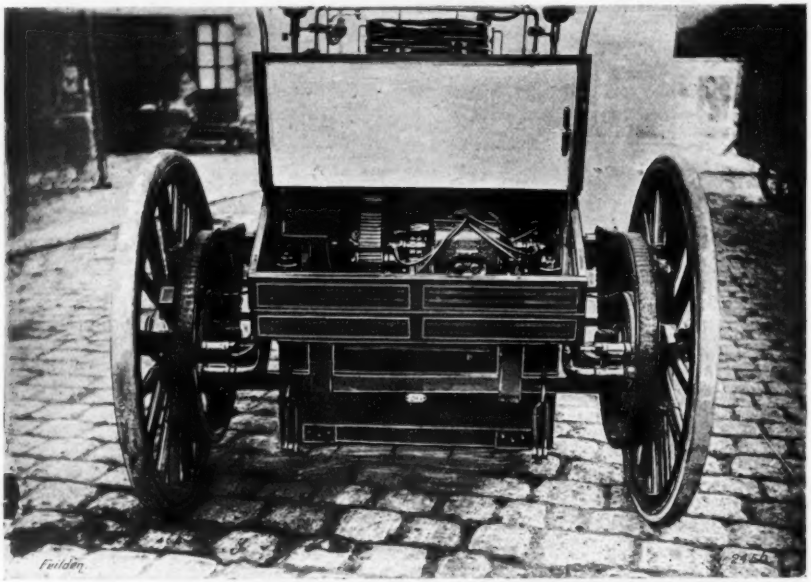


FIG. 11.—END VIEW OF CAB, SHOWING MOTORS AND ACCUMULATOR BOX.

ential coupling, and the frame work amounts to 528 lbs.

The different speeds are produced by varying the way of coupling the windings on magnets and fields; the diagram which follows shows that the first two speeds are obtained by coupling the two magnets and the two fields in series; the third by coupling the two fields in parallel and the two magnets in series; to obtain the fourth all are coupled in parallel. A resistance is introduced for stopping and for applying the first brake. The battery is invariably charged at from 80 to 85 volts. The speed-combiner, which is on the principle of a telephone exchange board, was designed and constructed by the Société Industrielle des Téléphones; it consists of a cylinder, on the axis of which a pinion is keyed, worked by a toothed sector attached to a lever actuated by the left hand of the driver. The diameter of the sector is such that a quarter turn corresponds to a whole turn of the cylinder. The lever is brought forward to produce a forward movement or increased velocity, and pushed back to diminish the velocity or change the direction of motion. The speed combiner gives three forward velocities corresponding with $1\frac{7}{8}$ miles an hour, $3\frac{3}{4}$, $8\frac{3}{4}$, and $10\frac{5}{8}$, also "stop," applies the electric brake, and produces a backward velocity of $1\frac{7}{8}$ miles an hour. The arrangement is clearly shown in the accompanying diagram (Fig. 12).

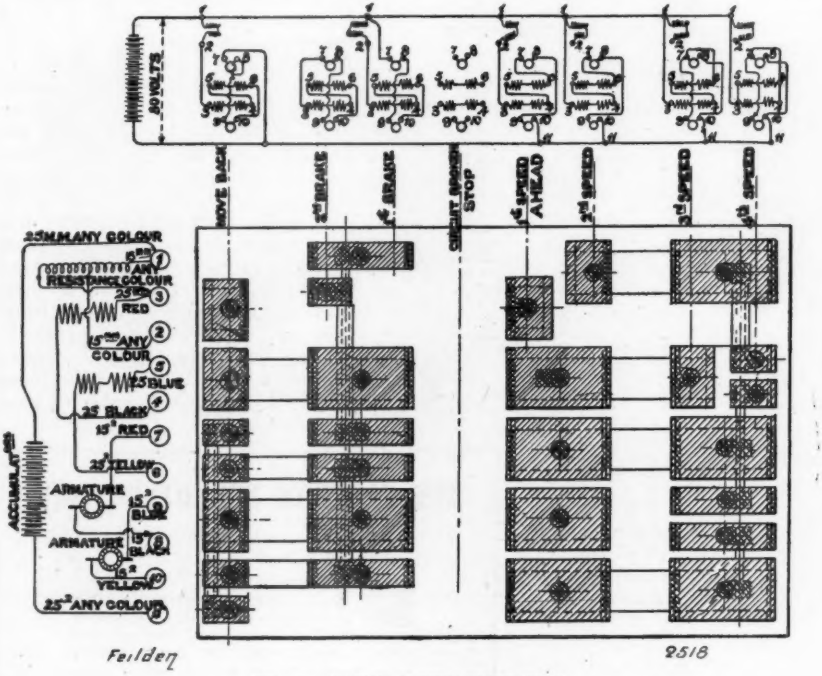


FIG. 12.—DIAGRAM OF SPEED COMBINATIONS.

The cabs are well provided with brakes, two electric, a coiled "Lemoine" friction brake, and a block brake. The electric brakes are worked by the lever of the speed combiner, the first being put on, as shown in diagram, by short-circuiting the motor on a resistance, the second by

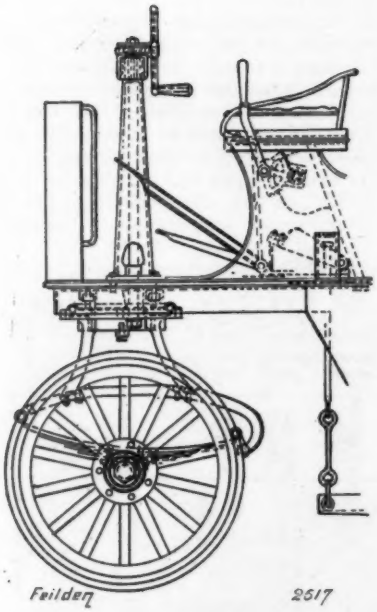


FIG. 13.—FRONT OF CAB, SHOWING DRIVING AND BRAKE GEARS.

short-circuiting it on itself. The coiled friction brake acts on two drums fixed on the inside of the motor wheel hubs; it is worked by the short pedal, which, when depressed, lifts a cam which cuts out the current and then acts on a transverse cranked axle which brings the two coils into play. All three of these brakes act only when the motion is ahead. The block brake is worked by a long pedal, and cuts out the current in a similar way, and can be kept applied by a rack in the teeth of which the end of the pedal can be fixed at will.

After each application of the brake the speed combiner must be brought back to "stop," the start made, and the speed gradually increased.

When the cab is standing, a bronze key of special design, which acts as a circuit breaker, is turned through 90 degrees and taken out by the driver. When starting, this is replaced and the motion reversed, whereupon the key presses against two spring clips which complete the circuit and allows the current to pass.

The cabs are lighted entirely by electricity, and a much appreciated innovation is the internal lighting afforded by a five-candle-power lamp fitted to the centre of the roof.

From the point of view of the Parisian public three circumstances have militated seriously against the popularity of the electric cabs: (1st) the difficulty of obtaining them, as the Compagnie Generale des Voitures à Paris attached these cabs, before the opening of the Exhibition, only to one or two stands along the main boulevards; (2nd) the excessive fares charged—these have been two or three times the ordinary one-horse cab fare; and (3rd) the risk of accumulators giving out when a trip to the suburbs is in progress, or when the cabs are engaged after having been busy with a larger number of short

THE GLASGOW EXHIBITION, 1901.

ARRANGEMENTS have now been completed whereby the Engineering Exhibits at the Glasgow International Exhibition will be described and criticised in a series of articles which will appear regularly during the time the Exhibition is open.

Prominent authorities, such as Mr. Sydney F. Walker, M.I.E.E. *Electrical Machinery*, Mr. James Wade, *Textile Machinery*, Mr. John Ashford, A.M.I.Mech.E., *Machine Tools*, &c., in each section have been commissioned to proceed to Glasgow. The name of these and every other contributor will be a sufficient guarantee as to the character of the articles.

THE GLASGOW EXHIBITION, 1901.

fares than usual. Otherwise there is no question as to their popularity and its ample justification. It is more than a pity that our London cabs should have been withdrawn instead of improved and perfected to the Parisian level.

As long as the much sought after light weight accumulator remains undiscovered and reliance, even of a moderate character, can be placed only on the cumbersome heavy weights, so long will the commercial success or failure of electric traction as applied to cabs and automobiles depend upon the situation and number of practicable charging stations available for these vehicles. The Parisian Cab Company have been forced to limit the number of electric cabs placed at the disposal of the Parisian public, because their main charging station is situated at such a distance from the centre of Paris (five miles), and because they possess only one small subsidiary station two miles from that centre; the capacity of the latter (ten sets of accumulators) has practically governed the number of cabs that have been placed on the streets to ply for hire. The same conditions have so increased the cost of working that electric cabs plying for hire at ordinary fares would be worked at a loss. Thus the sole causes of dissatisfaction with the Parisian electric cabs are wholly connected with the question of recharging the accumulators and the operations involved thereby. It is needless to add that difficulties connected with the same causes led to the withdrawal of the London electric cab.

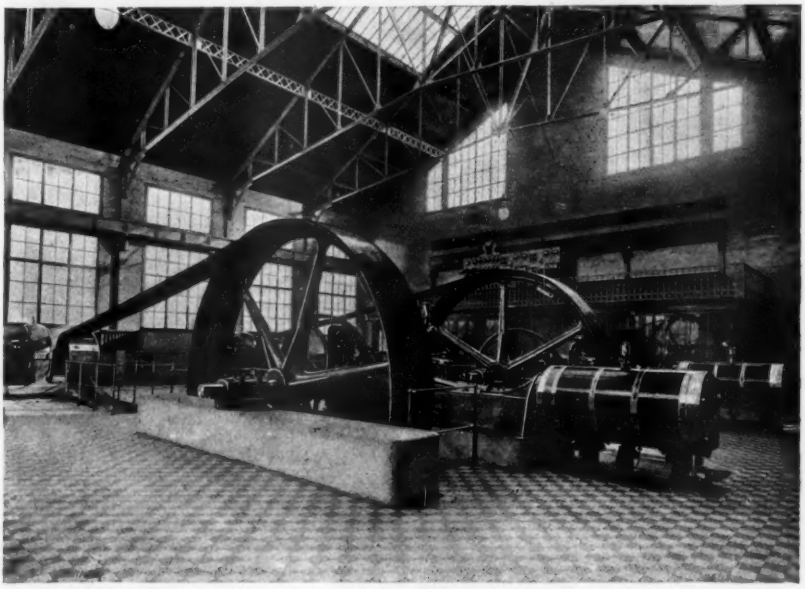


FIG. 13.—INTERIOR OF DYNAMO ROOM, FROM THE DRIVING SIDE.

The accompanying general plan shows the arrangement of the Cab Company's main generating station at Aubervilliers—*A* being the machinery building, including boiler room, dynamo room, &c.; *B*, accumulator charging room on two floors; and *C*, the automobile cab station, to

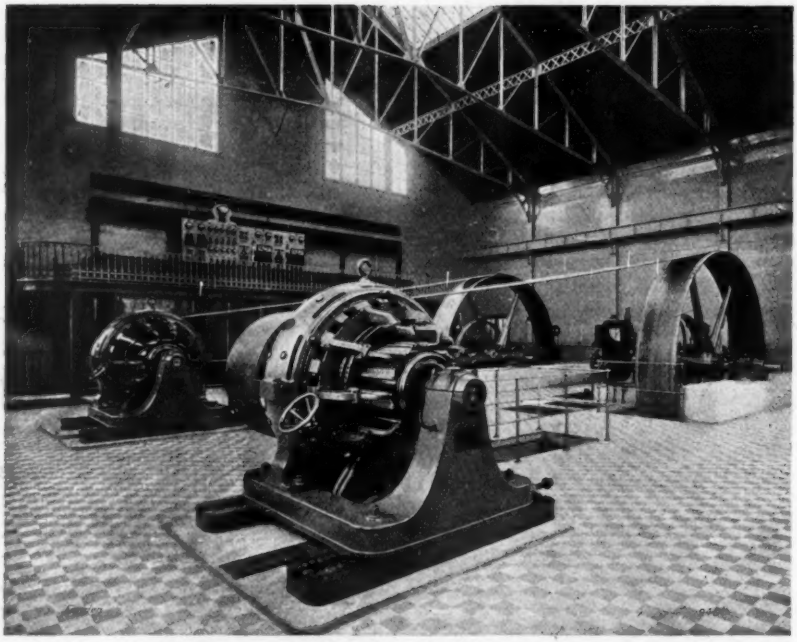


FIG. 16.—INTERIOR OF DYNAMO ROOM, FROM DYNAMO SIDE.

contain 125 cabs. Around the two last buildings runs a training track 654·50 mètres (2,147 ft.) in length, divided into various kinds of paving and inclinations as follows :—

290·60 m. of 1 in 373, paved with granite sets.
54·00 m. of 1 in 182, asphalte pavement.
84·00 m. of 1 in 20, wood pavement.
76·00 m. horizontal, various concrete pavemts.
40·00 m. of 1 in 10, paved with granite sets.
110·00 m. of 1 in 113, macadam.

This track is used for the indispensable training of drivers, and is laid out so as not to interfere with future extensions of the buildings.

Figs. 5 and 6 show an elevation and plan, and Figs. 15 and 16 interior views of the machinery building, whose dimensions are 33 mètres (108 ft. 3¼ ins.), by 16 mètres (52 ft. 6 ins.) by 15 mètres (49 ft. 2½ ins.) high.

There are two semi-tubular boilers of the Elephant type, having three heaters each, and with 2152·82 sq. ft. of heating surface in their external fire-boxes and flues, working pressure 121 lbs. to the sq. in., built by Bonnet and Spazin, of Lyons. Water is fed by a separate Worthington pump, or alternatively by the ordinary pumps attached to the engines, and is drawn from a well sunk through the surface water-bearing strata, lined throughout with a wrought steel tube and a concrete ring, and carried down to the water-bearing greensands at a depth of over 357 ft. The internal diameter of the tube is just under 1 ft., and the water is raised by a "sheath pump" worked by an electric motor fixed in a chamber at the surface. The duty of this pump is 5,550 gallons an hour raised 36 ft. 1 in. above the level of the ground and delivered into a tank of the capacity of 15,414 gallons (70 m.^{3}).

The chimney, built for five ranges of boilers, has a flue 9 ft. 3 ins. in diameter and is 131 ft. 3 ins. in height. The engine-room, which is particularly airy and spacious, contains two horizontal single cylinder, surface-condensing engines (diameter 1 ft. 8 ins., stroke 3 ft. $3\frac{3}{8}$ ins., revolutions 100 per minute), developing at the working pressure of 107 lbs. to the square inch, 276 h.p. effective, built by Messrs. Piguet of Lyons. (See Fig. 15.) The condensation is effected by pumping the hot water from the condenser below the engines, through a system of perforated cooling-pipes placed outside the building, whence it escapes in small jets into the air, is cooled down to the temperature of the latter very rapidly, and gravitates into a cold-water tank, from whence it is again supplied to the condensers. The coal consumption averages $3\frac{3}{4}$ lbs. per kilo-watt hour, when a minimum of 80 kilo-watts are generated and 3·63 lbs. at full load. Each of the horizontal engines drives by means of a flywheel (16 ft. 5 ins. in diameter) and belting (width, 2 ft. $1\frac{1}{2}$ ins.) an "Alioth" decapole generator developing 150 electrical h.p. at 400 revolutions (Figs. 16 and 17), and weighing 1,763 lbs. They are self-excited by shunt induction, the inducing current taking from $12\frac{1}{2}$ to 15 ampères at full load. The electrical yield is 94 per cent. and the commercial yield 84 per cent. The 10-brush carriers are supported on two collecting rings and each carries six copper-plated carbon hammer-head brushes. The collectors are built up from 210 thin plates, and the inductor is of foil ($\frac{4}{10}$ mm.), insulated with paper. The current generated is conducted by four cables of 0·465 sq. in. section from the dynamos to the switchboard.

The switchboard, supplied by the Société Industrielle des Téléphones (see Fig. 17) consists of two generating panels, two feeder or distributing panels, and one general panel for lighting and workshop, all of white marble. Each panel carries a voltmeter, an ammeter, a rheostat, and lead fuses. On one pole is fixed an automatic polarised switch, with four bobbins, two shunt and two series wound, which operate when the current changes in direction. On the other pole is a single-pole circuit breaker, with carbon jaws. Above the general panel is a luminous registering voltmeter and 2,500 ammeter, the former being always in circuit. The lead-sheathed feeder cables from the switchboard to the charging room are of 0·775 sq. in. diameter, and are designed to carry 800 ampères; and run both from ground floor and basement, in cast-iron pipes buried in the

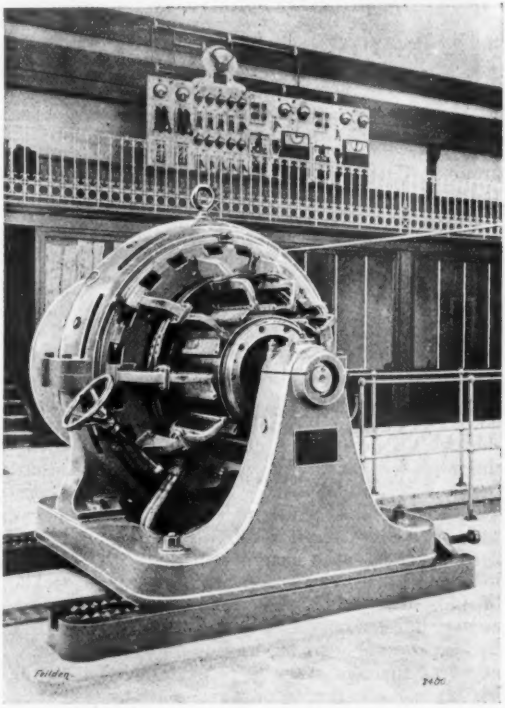


FIG. 17.—ELEVATION OF DYNAMO AND SWITCHBOARD.

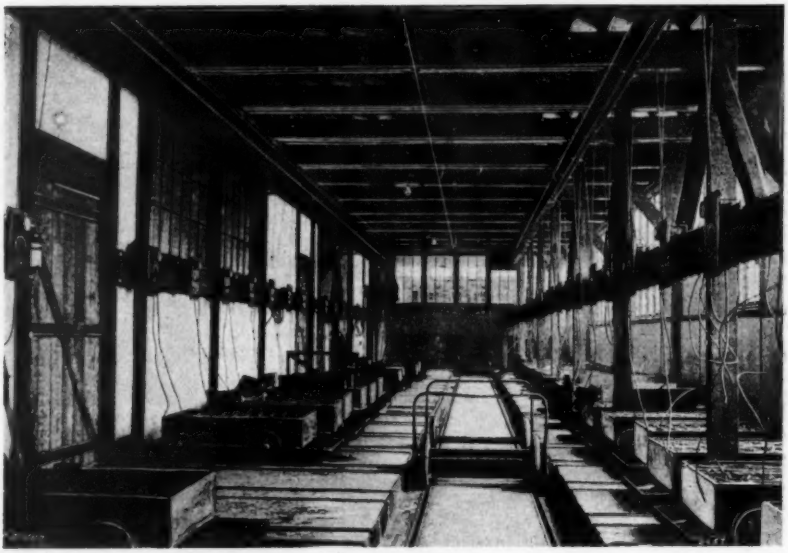


FIG. 18.—INTERIOR OF CHARGING STATION, SHOWING ACCUMULATOR BERTHS (LOWER STOREY).

ground. The basement, which runs below the whole engine-room, enables all cables and connections to be easily inspected and instantly got at when required. The whole of the mechanical and electrical fittings have been designed and installed by the Société d'Applications Industrielles.

The most original part of the whole installation is the charging station for accumulator batteries, which is a building on two floors over 130 ft. in length, and contains a 54-berth charging room on the ground floor and a double room on the first floor with 52 and 53 charging berths respectively. (See Figs. 18 and 19.) Down the centre of each room runs a line of rails for the discharging carrier, and each charging berth has its independent carrier on its own pair of rails arranged at right angles to the central line. Light and air are supplied by large wide-opening windows. The effect of the acid vapour is neutralised by tarring all the woodwork, and by making the floors of a mixture of asphalte and sulphate of lime. The expended acid water runs off to the sewers through lead conduits communicating with each berth. The distributing switchboards of five panels are placed behind a glazed screen at the end of each room, and consist of one arrival panel with an ammeter for 800 ampères, a voltmeter and a bipolar circuit breaker, and four departure panels, two for the right side and two for the left side, with ammeter, fuse, and automatic switch (non-polarised) and unipolar circuit breaker. The current is distributed to the charging-berth boards, along triple naked feeder cables of ·093 sq. in. section, painted different colours to distinguish the positive and negative sides, the acid vapour having been found destructive of all other kinds of insulation.

The charging-berth boards carry an ammeter and rheostat, a fuse, a circuit breaker, and two flexible charging feeders firmly connected one with each pole, so that any inversion of current in the batteries is impossible. The charging current is delivered at 110 volts; the batteries take nine hours to recharge, the

first 25 ampères being taken up in two hours, and the balance in the succeeding seven hours; all three conductors composing the feeder are used till one-third of the charge is taken up, then two, and finally one for the last one-third.

To remove the expended accumulators and replace them by recharged batteries the *modus operandi* is simple and expeditious, the importance of the time element in handling the batteries being thoroughly recognised.

Under the covered verandah are three sets of two double platforms with inclined ends, up which the cabs whose accumulators require to be dealt with, are run. These double platforms have an inner and an outer groove to take the front and hind wheels respectively, and a small hydraulic lift just large enough for the battery carrier (a low four-wheel trolley) which works in between these platforms. The cab having been run up into place, the carrier is placed just underneath the accumulator battery, the lift is worked, and the battery raised and the springs compressed, so as to allow of its being unhooked from the suspending chains; the lift is then lowered, the carrier with battery removed, and the recharged battery replaced by reversing all the operations. The batteries to be berthed on the upper floor are taken up with their carriers by three hydraulic lifts working between the two floors. The details of the hydraulic installation comprises six lifts of 1-ft. travel and three of 15-ft. travel, each with platforms 5 ft. 4 in. by 4 ft. 3 in., and pistons $4\frac{3}{4}$ ins. in diameter, working in cylinders $\frac{5}{16}$ in. thick, with friction stuffing-boxes without leather; the water being delivered at 312 lbs. to the square inch, their lifting capacity is 1·13 tons. A receiver of 35 cub. ft. capacity, fed by charges of two cub. mètres each, delivers water to two twin pumps through suction pipes 1·95 ins. in diameter; a single pipe delivers the water to the hydraulic ac-

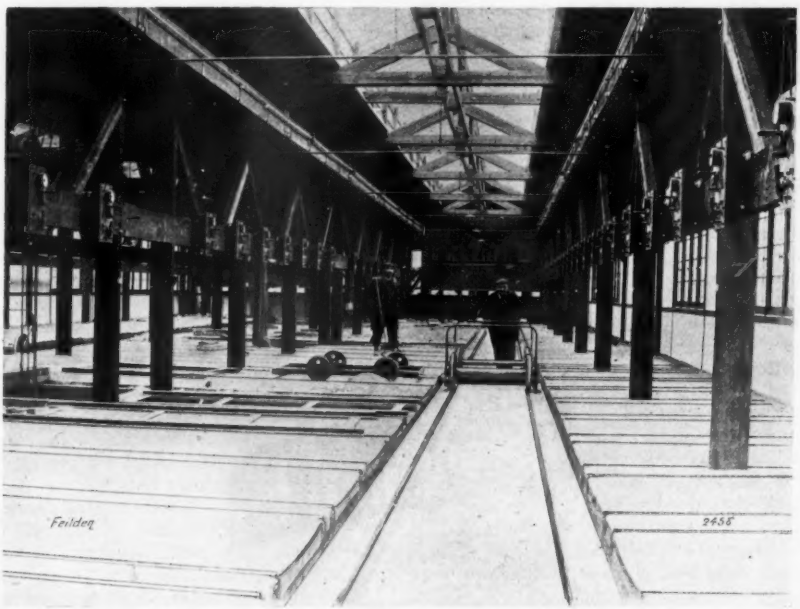


FIG. 19.—INTERIOR OF CHARGING STATION (UPPER STOREY).

cumulator fixed in an adjoining room. This delivers the water at the rate of 46¼ gallons a minute, and has pistons of 1 ft. 1½ ins. diameter and 6 ft. 3 ins. stroke, weighing 22 tons. A stop-valve enables the accumulator to be isolated in case of burst pipes, and an overflow valve with 3½-in. connections is provided to avoid over accumulation. The accumulator works a three-way cock, automatically delivering the water under pressure at the lifts, and the overflow to a service motor, which, by means of a liquid resistance, actuates or stops the dynamos working the compressing pumps. All the piping is of copper and disposed in trenches that can be readily got at. The dynamos working the pumps are of the Alioth type, of six electric h.p. at 1,500 revolutions; they are shunt-excited. Spur gearing reduces the revolutions to 40, at which the pumps are worked. The pumps are duplicated in case of breakdowns.

The automobile house is capable of holding 125 electric cabs, and can be extended to hold 1,000 if necessary. It is light, convenient, and inexpensive in construction. Convenient workshops are attached.

A few words about the sub-charging station at the Rue du Cardinet will suffice. This is fitted with 10 recharging berths only, and obtains its current from the Clichy generating station at 440 volts, which it reduces to 110 volts by a continuous current transformer of the Belfort type, consisting simply of a 40-ampère dynamo receiving at 440 volts, on the same shaft with which is mounted a generating dynamo of 90 to 100 ampères at 110 volts.

The successful adaptation of electric traction to automobiles and cabs depends chiefly on the judicious multiplication of charging stations of this type, and their location at convenient sites in the principal districts of capital cities and towns along the main highway arteries. Paris, which is generally so well supplied with most conveniences connected with automobiles, in addition to the above-mentioned sub-charging station, only possesses one more station more or less open to the public belonging to the Compagnie Française des Voitures Automobiles. This drawback the General Cab Company will have to expend capital in remedying ere they will be in a position to reap the reward they deserve from the large capital they have so pluckily devoted to the development of electric traction applied to automobile cabs. If they should not do so soon, it is to be hoped that London will seize the opportunity, and once more take the lead it has temporarily abandoned.

WELL STOPPED!

The Glasgow International Exhibition.

By OUR SPECIAL COMMISSIONER.

MR. H. A. HEDLEY,
General Manager, Glasgow International Exhibition.

In the jubilee year of Exhibitions (for it is just fifty years since Prince Albert opened the first show at the Crystal Palace), and in the first year of the twentieth century, an International Exhibition will be held in Glasgow with special claims to the attention of readers of this magazine.

In 1888 a very successful Exhibition was held in that city, the profit from which formed the basis on which the present great enterprise has been built up. The promoters have adopted the same site. While they have done so they have laid under contribution other adjacent ground, which adds largely to the space for exhibits. More than two years have elapsed since the project of organising an International Exhibition in 1901 was decided upon, and during that period the Executive Council have worked assiduously to perfect the details of the vast undertaking. The work of construction once begun was carried on without intermission, and with only such delays as were incidental to the weather and (for a portion of the time) to the scarcity of steel.

There is nothing Scottish about the design of the buildings, which, indeed, is much after the style of an Eastern palace. The general idea is that of a Sultan's palace and gardens. Mr. James Miller is the architect, and he has chosen a phase of Spanish Renaissance which flourished in the sixteenth century, and the general feeling of which is decidedly Oriental. In character and picturesqueness the buildings harmonise with the new permanent Art Galleries, built out of the profits of the last Exhibition. The style is most conspicuously developed in the Industrial Hall, which constitutes the main portion of the Exhibition. The grand or ceremonial entrance is towards the Kelvingrove Park, in the centre of the north façade, which is treated with much originality. The front of the building is deeply recessed, so as to form a piazza about 200 ft. long by 100 ft. wide, behind a peristyle of a double range of classic columns 30 ft. high, which, forming a screen nearly 200 ft. long, continues the line of the north part of the buildings. The piazza is paved with white cement, with a large geometrical design in black. Round the whole building there runs an arcade of arched windows, the openings being divided by balustrades, which are supported on cherubs' heads moulded into the cornice beneath. These arches are flanked at the end of each bay by corner towers about 32 ft. square, rising to a height of 60 ft. The towers are surmounted with flattish domes, terminating by flagstaffs carrying national flags. At the centre of the side wings there is a hanging Spanish balcony, on the top of which is a figure supporting a great torch, emblematic of Electricity. The approach to the grand entrance is by a great flight of steps rising from the main promenade in the Park. This promenade extends from the Russian section at the extreme

east of the grounds, and has a continuous stretch on the east side past the Canadian section and along the front of the Industrial Hall and Art Galleries.

The Sandyford Street front forms one of the principal entrances for the public, as the electric cars run right up to the door. The central feature of this front is entirely different from that at the entrance in the main façade. It is flanked by two tall towers, and projecting towards the street there is a huge semi-dome bulging out into a verandah, giving a variety of curve which harmonises with the straighter lines of the towers and gables behind. Another front, in Gray Street, is flanked by two tall towers, 120 ft. high, with a deeply-recessed semi-circular arch, springing about 20 ft. off the ground and nearly 50 ft. in diameter. A verandah runs along the whole length of the towers.

A striking feature of the whole design is the group of towers in the centre of the Industrial section. It is composed of a great central dome surrounded by four towers rising to a height of about 160 ft. From the apex of the dome, which is 135 ft. from the ground level, there rises a beautifully-decorated flèche 32 ft. high. Posing on the flèche is a figure emblematic of Electricity, similar to that placed on the top of the Spanish balconies on the main façade. The whole dome rises, with its surmounting flèche and figure, to a height of 180 ft. The four towers which surround the dome at an effective distance form at their base the corners of an open arched balcony, to which visitors have access, by means of electric hoists in the south-east tower, and by staircases built within the north-west tower. This balcony is 500 ft. in circumference. Between the dome and the four main towers, and in line with the diagonals of the latter, are four artistically-designed minarets. The cupolas of the four great towers, and also the cupolas of the minarets, are covered with gold; the main building is finished in pure white, with the roofs of the domes painted pale green. The eight corner towers are covered with red Spanish tiles, and the corrugated iron running along the roof between the towers is painted a bright orange tint, while the woodwork of the red-tiled wide-spreading eaves is green.

The external finishing of the buildings, including all the decorative work, is formed of fibrous plaster, composed of stucco, canvas, and wood. The plain work was made in boards 2 ft. by 4 ft., ¾ in. thick, nailed to a wooden framing, pointed, and flushed up in stucco when in position. The ornamental work was cast into large moulds of the same material. The buildings are thus really in one great piece. The section which is devoted to industrial exhibits comprises the main part of the interior, the other great department being the Machinery Section. At the west end of the Industrial Hall a Grand Avenue has been constructed to connect these two portions. This Avenue is one of the most interesting features of the interior. It is 1,000 ft. long, 75 ft. wide, and 40 ft. high, formed of semi-circular, wood-laminated arches, carrying a glass-worked roof, supported on iron astragals. It sweeps to the west and south with a graceful curve, and forms the main artery to the Machinery Section, erected on the Bunhouse grounds. The public roadway between the end of the avenue and the Machinery Hall is spanned by a wooden bridge, built on the canti-lever principle, which clears the road traffic at the height of 18 ft. 3 ins. The whole range of buildings is so designed that the visitor has never to ascend or descend a flight of steps after entering, unless to mount the towers.

As the Machinery Hall will have most interest for our readers, we pass over the remainder of the Exhibition and proceed there at once. The first feeling on entering it is one of space, for it is one vast chamber unbroken by courts or aisles. It is 500 ft. long and 330 ft. wide, and is covered by an arched steel roof of open girder work, supported by double columns 8 ft. apart. These columns, while supporting the roof, also carry a gallery with lines of shafting underneath for conveying power to the machinery in motion, as most of the machinery exhibited is intended to be. This gallery, which is 16 ft. wide, is on a level with the floor of the Grand Avenue, and is carried round the hall, so as to afford the visitor a clear view of all opera-

tions. Beyond the main building of the Machinery Hall, and at its south-west corner, is the Dynamo House, about 100 ft. square. Along the west side is the Boiler House, 204 ft. long, 70 ft. wide, and covering about 1,600 square yards, covered by a single span roof of open timber-work, and surrounded by a gallery from which the spectator can survey the whole. There is a siding connecting with the Caledonian Railway, both for the delivery of exhibits and for coal supply, and a covered way for passengers to the platform of Partick Central Railway.

INTERIOR VIEW OF INDUSTRIAL HALL.

Here, then, in the Boiler House, we are at the fount and origin of the power on which the mechanical success of the Exhibition depends. And here we may best begin our survey of such exhibits as belong also to the working machinery of the Show, leaving other exhibits for description after the concern is in full working order. First, then, are four Lancashire steam boilers, lent by Messrs. Penman & Company, Strathclyde Street, Glasgow, each of which is 30 ft. long by 8 ft. in diameter, and is designed to work daily at a pressure of 120 lbs. per sq. in. The fire-grate area in each case is 39 sq. ft., and the flues are fitted with the ordinary cone tubes to increase the water circulation, while the safety-valve and other mountings consist of dead weight and the customary appurtenances. These boilers will supply steam to the various exhibitors requiring such motive power.

All the flues converge into one main at the rear of the boilers, having an area of 20 sq. ft., into which the hot gases are led through one of Messrs. E. Green & Son's Economisers, possessing 192 vertical tubes, arranged in two nests of 96 each. The feed-water is pumped into the inlet pipe at the bottom of the vertical pipes, which, in their turn, lead the water upwards and transverse to the course of the heated gases,

which should have a temperature of from 550 to 700 degrees Fahrenheit on leaving the boilers. The water in the Economiser tubes will travel at the rate of three inches per hour. The hot water is then conducted into the check feed valves placed in front of each boiler. Scrapers are fitted to the vertical tubes to prevent loss of efficiency through the tubes becoming dirty or scaled, and these scrapers are kept continuously in action, removing the soot as fast as it is deposited, by a small steam engine attached to overhead shaft and gearing. At the bottom of the chamber in which the Economiser is built is a pit into which the soot falls, whence it is removed from time to time. A bye-pass flue is built alongside the Economiser and fitted with swivel dampers.

The Sturtevant Engineering Company give the use of an induced-draught plant, which is placed between the chimney and Economiser, and consists of a large fan built alongside of, and connected with, the interior of the flue by sheet-iron suction and discharge pipes. This fan is driven by a 5 in. × 4 in. vertical steam-engine at 450 revolutions per minute, which draws the products of combustion from the flue, producing a partial vacuum, and inducing the additional air required through the fires.

GENERAL VIEW OF MACHINERY HALL (SECTION).

Water-tube boilers are used to generate steam for the electric engines at 160 lbs. pressure per square inch. Adjacent to the Lancashire Boilers, is one of Messrs. Davey, Paxman & Company's patent Economic Boilers, 14½ ft. long by 8 ft. 9 ins. in diameter, with return fire tubes over the furnaces, somewhat similar to an ordinary marine tubular boiler; but instead of the gases passing direct into the smoke stack when leaving the return flues, they are again passed along each

side and bottom of the boiler into a back flue, and subsequently led into the chimney. One of Green's patent Economisers is placed behind the boiler to utilise waste heat. Attached to the side of this boiler, and directly connected with its flues, is one of that firm's superheaters, provided with dampers which are manipulated by levers in front, so that, when desired, the saturated steam may pass through the process of superheating before entering the engines.

Then the Stirling Boiler Company, Limited, Edinburgh, supply two of their special water-tube boilers, each with a grate area of 54 sq. ft., and heating surface of 3,250 sq. ft. The tubes in these boilers are nearly vertical, and are arranged in staggered rows, thus dividing the fire gases into small sections, so that before leaving the boiler they are made to pass successively over the whole length of the different banks of tubes, and pass off where the feed-water enters. By this means the temperature of the gases is reduced to a minimum before entering the chimney. It is claimed for this interesting boiler that the steam, in consequence of the peculiar arrangement of the tubes, is exceptionally dry; that it is specially adapted for high pressure; and that it is very easily cleaned and repaired. One of these boilers is fired with a Vicar's Mechanical Stoker, and the other is gas-fired by means of gas from a producer lent by Messrs. W. F. Mason & Co., Manchester. This producer is capable of converting into gas 15 cwt. of coal per hour. The producer furnace is situated outside the Boiler-House, and the gas is conducted to the specially prepared boiler fire-place by means of a brickwork flue laid under the floor, fitted with cast-iron manholes, &c.

Messrs. Babcock & Wilcox, Limited, provide two of their well-known large-sized boilers, each with a heating surface of 5,137 sq. ft. Each of these boilers contains 234 wrought-iron tubes, each 4 ins. in diameter, with ends expanded into continuous staggered headers. The several sections are connected at the rear end with a steel cross drum of 20 ins. diameter, 8 ft. 6 ins. long, on which is placed the 7-in. saturated steam valve. In addition, each boiler is fitted internally with one of the firm's patent superheaters, capable of imparting from 100 to 120 degs. Fahr. superheat to the steam produced. The boilers are suspended from wrought-iron girders resting on cast-iron columns with cast bases, so that they are sustained independently of the brickwork, and free to expand or contract; each boiler is also provided with a Babcock & Wilcox chain grate stoker, worked by eccentrics on a shaft on the upper front of the steam drums. Under favourable conditions of steam consumption in the engines, these boilers will be good for 2,000 i.h.p. Adjacent is one of the same company's marine type of boiler, similar to those supplied to the Allan steam-ships. The water-tubes are $3\frac{3}{16}$ ins. in diameter, and lie straight on an incline, as in the land boiler; but in this type the steam and water drum, which is 36 ins. diameter, is placed transversely over the tubes and in front with a partial overhang. The grate area is $55\frac{1}{2}$ sq. ft., and the heating surface 2,050 sq. ft.

Each of the water-tube boilers (excepting the Babcock & Wilcox Marine) has a wrought-iron chimney, 80 ft. high by 4 ft. internal diameter, with brick base $8\frac{1}{2}$ ft. high and 7 ft. square, capped with a cast-iron base plate, built in four sections and bolted together, every plate being secured to the brickwork by four anchor bolts, each 8 ft. long. The Marine boiler has a 3-ft. wrought-iron flue led into and connected by a riveted flange to the nearest chimney. The four Lancashire boilers have one wrought-iron chimney in common, 80 ft. high and 6 ft. internal diameter, which also rests on a cast-iron ribbed bed-plate, built in segments and secured to a brickwork foundation by long tie bolts. The chimneys and bases are suitably protected by a lining of fire-brick, the funnels being maintained in their position by $\frac{3}{4}$-in. flexible steel guys, fitted with tightening screws, etc.

As the supply of coal to these ten boilers, averaging a working capacity of 5,000 i.h.p., is a considerable item, the fuel is delivered in the Boiler-House by a siding, as has been said, from the

Caledonian Railway, passing first over one of Messrs. W. & T. Avery's patent automatic weighbridges, with a capacity of 20 tons, and built on the cantilever principle.

Closely associated with the question of the fuel supply is that of the utilisation of the waste heat and waste steam, with a view to the regularisation of the temperature at which the boilers are fed—a most important point. The waste heat from the fires is utilised in the Economisers. And now a word is due to the feed-water heaters in use as working exhibits. First of all, Messrs. Joseph Wright & Co., of Tipton, supply two Excelsior Patent Non-pressure Heaters, which contain filter and oil separator, and two No. 12 Berryman Patent Heaters. These heaters, which are placed in the southern end of the Boiler-House, are 16 ft. and 19 ft. 6 ins. high respectively, each being 3 ft. 6 ins. in diameter. The Excelsior type is supplied by water at gravitation pressure through a 4-in. automatic feed-valve, and falls over spreaders on to a steam baffle-plate, and then through perforated grease plates into a chamber whence it is drawn by the pump. In the Berryman type the feed-water is forced under pressure by the pump and discharged from the top by a 5-in. outlet. These heaters will be served by a set of Messrs. Worthington's 9-in. and 6-in. by 12-in. vertical direct-acting feed pumps, capable of delivering 35,000 lbs. of water per hour against a pressure of 160 lbs. per sq. in.

In the Feed Heater and Pump Room are two of Messrs. Royle's Class A heaters, and two of Class B. The former are steam-fed through 10-in. exhaust inlet branches on the upper part of the heater, the steam circulating, as it descends, around a number of Row's patent indented tubes made from solid-drawn copper pipe, which forms the speciality of this firm's heaters; at the same time the feed water is forced upwards through the tubes, which in consequence of their peculiar formation offer a large surface to the action of the steam. The heaters are fitted with drain pipes, relief valves, pressure gauges, &c., complete, and occupy comparatively little space.

They are served by a set of Messrs. Carruthers' compound vertical duplex pumps, with cylinders 5 ins. and 9 ins. diameter, and pumps 5 ins. by 10 ins., capable of delivering 35,000 lbs. of feed water per hour against a pressure of 120 lbs. per sq. in., and are fitted with positive valve gear—that is to say, the gear is actuated directly by means of levers from the pump rods.

The B Class heaters are worked in conjunction with a set of Messrs. G. & J. Weir's patent vertical direct-acting feed pumps, with cylinders 9½ ins. diameter, pump 7 ins. diameter, and stroke in each case of 21 ins. These pumps have been largely used in marine work, and have now been specially adapted for stationary purposes. The steam works expansively, and, while thus aiding economy, enables the piston to slow down at the end of each stroke, thus preventing jarring in the valves. This class of heater is specially designed for water containing sediment or chemical impurities, and has ample provision of inspection and cleaning doors. The feed pipes are arranged to work on a duplicate system by a series of stop and check valves, so as to lessen the possibility of even a temporary withdrawal of the water supply.

In now proceeding to a description of the machinery in use, we have to express indebtedness to the courteous engineer of the Exhibition, Mr. Thomas Young, of whose notes we gratefully avail ourselves, as the machinery was not yet in position while this article was being written.

We take first the main Electric Engines, installed to generate current at 250 and 500 volts for lighting purposes, and for supplying motive power to exhibitors. Messrs. Davey, Paxman & Co., Ltd., exhibit at work a coupled compound electric traction engine of 30-in. stroke, running at 150 revolutions per minute, and directly attached to one of the London Electric Construction Co.'s dynamos. The high and low pressure cylinders each work in a trunk or horn, with heavy bearings for the crank journals and auxiliary cranks and bearings for the valve gearing. Connected between the steam pipes of the cylinders, in an intermediate position, is a

re-heater with a supplementary steam pipe branch from the live steam main, for the purpose of equalising, to an extent, the temperature of the steam fed to both high and low pressure cylinders. This engine and dynamo supplies electricity at 500 volts.

There are two Willans & Robinson vertical central valve type of engine, which is now so extensively used in power station plant. These engines have three cranks and three lines of cylinders, and as they are triple-expansion there are three cylinders to each line. The crank-shaft is in one piece with the eccentric forged solid on the middle of the crank-pin. Because of the uniform turning moment given by the three cranks, a large fly-wheel is unnecessary; in fact, the armature of the dynamo acts in its place, the coupling disc between engine-shaft and dynamo acting for barring round. Each piston-rod is hollow like a pipe, and within works the line of piston-valves distributing steam to the cylinders. The line of valves is worked by an eccentric rod coupled to the eccentric on the crank-pin, and on either side of the eccentric rod is a connecting rod coupling the crank-pin with the crosshead or guide piston. Thus, on each crank-pin there are coupled two connecting rods and one eccentric. Each engine is capable of developing 1,500 i.h.p., the average working being 1,200, and giving electric current at 500 volts. One engine has a Crompton dynamo attached, while the other works in conjunction with a Schuckert generator.

GENERAL VIEW OF MACHINERY HALL (ANOTHER SECTION).

A coupled compound horizontal engine, exhibited by Messrs. Robey, of Lincoln, is also in use. Its cylinders are 20½ ins. and 35 ins. diameter, with a 42-in. stroke, making 90 revolutions per minute, and developing 500 i.h.p. This engine acts in consort with a Mavor & Coulson dynamo, and has on the main shaft a fly-wheel

16 ft. in diameter, each cylinder being fitted with Richardson-Rowland patent valve and trip gear. The same firm provide also a high-speed vertical compound engine with dynamo combined. The cylinders are 10½ ins. and 18¼ ins. diameter, with a stroke of 11 ins. In close proximity they have a vertical compound high-speed engine in combination with a Scott & Mountain dynamo. The cylinders are 8½ ins. and 14½ ins., with a 6-in. stroke, running at 550 revolutions per minute, with forced lubrication.

Messrs. Ruston, Proctor & Co. supply one of their high-speed vertical enclosed engines, the cylinders being 9½ ins. and 15 ins. diameter, giving an 8-in. stroke, combined with dynamo, and capable of indicating 100 h.p. Attached to this engine, as in several others, is a steam separator, or drier, to ensure the non-passage of water into the cylinders—a vital matter in high-speed plant.

Messrs. Bruce, Peebles & Co., Edinburgh, have a 200 kilowatt dynamo coupled to a Belliss & Morcom engine of the vertical triple-expansion high-speed type, with enclosed casings, to which is also attached a steam separator to steam inlet pipe. Messrs. Sisson & Co. have a vertical engine, indicating 125 b.h.p., combined with a Clarke-Chapman dynamo. An Alley & MacLellan three-crank tandem compound vertical engine, coupled with a six-pole dynamo, comes next. This engine will develop 300 h.p., and the dynamo is wound to give current at 500 volts. Messrs. Scott, Mountain & Co. and the Edison-Swan Electric Company also supply electric steam-plants generating current, the former with a compound vertical engine with 11¼-in. and 21-in. cylinders, 10 in. stroke, and indicating 130 h.p. The dynamo of the latter firm is coupled with a Browett-Lindley vertical compound engine, the cylinders of which are 12½ ins. and 21 ins. in diameter respectively. The stroke is 9 ins. and the engine is good for 200 h.p.

The steam pipes supplying the electric engines are designed on the ring system, and are arranged so that the main pipes do not exceed 12 ins. in internal diameter. They will be amply drained of all water accumulations by separators and steam traps with bye-pass facilities, while stop-valves are placed in such positions that the boilers can be entirely isolated in the event of water famine or other contingency, and also provide for the complete cut-out of any section of piping, or any engine, should a break-down occur. The large expansion incidental to high-pressure piping will be taken up by expansion joints with brass glands. The steam separators and valves, etc., are supplied by Messrs. Glenfield & Kennedy, Limited, of Kilmarnock, and the steam traps by Messrs. Royles, Manchester, and others.

The exhaust pipes, constructed by Messrs. Mechan & Sons, are adapted for giving temperature equal to 15 lbs. pressure to the feed heaters, the pressure being maintained or diminished by a 30-in. steam sluice-valve. These are also fully provided by steam traps of the Lancaster type with bye-pass drainage. The exhaust pipes range from 5 ins. to 36 ins. in diameter, with three outlets to the atmosphere, and, like the steam-pipes, lie on roller brackets over a level concrete track.

The electric generating station and plant is at the south-west end of the Machinery Hall, and consists of twelve sets of combined steam engines and dynamos, giving a total output at the terminals of 4,176 e.h.p. Five of these dynamos work at a pressure of 500 to 530 volts at the terminals, and seven work at a pressure of 250 to 265 volts. This range in the voltage is allowed in order to provide for loss in transmission to the various stations or points of distribution through the various sections of the Exhibition. Three of the dynamos are compound wound, but all are used as shunt-wound machines, and coupled up to the bus bars of the main switchboard—which consists of 15 panels of polished and enamelled slate slabs, and measures 31 ft. 9 ins. in length by 7 ft. in height—on the parallel system. Upon these slabs, and in front, are mounted the regulating, controlling, and recording gears, and connected to the respective bus bars which are mounted at the back of the slabs. Each dynamo

is connected to the bus bars of the main switchboard through an automatic magnetic circuit break switch, ampère meter, shunt regulator, and double-pole fuses. The main switchboard is also fitted with the necessary feeder logs, earth recorders, direct reading and recording volt and ampère meters, electricity meters, circular dial timepiece, etc. The shunt regulating resistance frames are placed in the space behind the switchboard, and connected by means of suitable links through the slate slabs to graduated handles in front, so that each can be easily operated by the attendant.

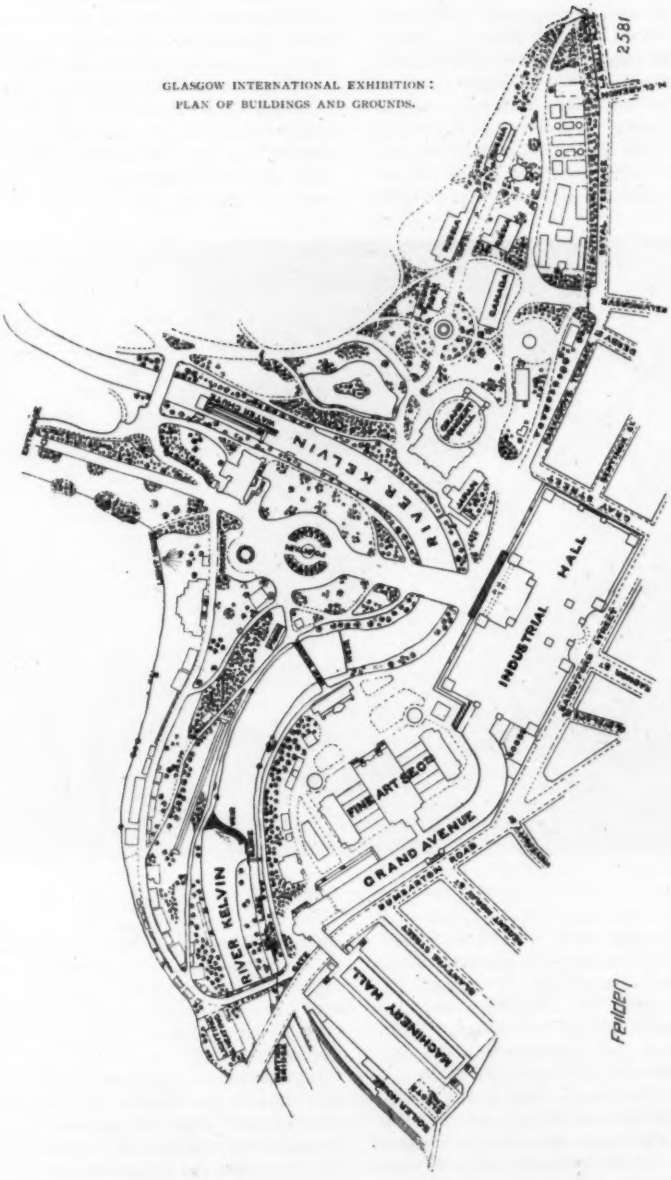
The sub or switch-distribution stations are six in number, arranged as follows :— Two in the Machinery Hall at the north-west and south-west ends ; one in the Grand Avenue ; and three in the Industrial Hall. From these stations all arc and incandescent lighting is controlled.

The incandescent switch and fuse boards are separate from the arc switch and fuse boards, both in the manner of erection and supply. Each arc or incandescent switchboard is fitted with two double-pole quick-break change-over switches, connected by an insulating link to form one change-over main switch, and the necessary number of single-arc circuit switches with double-pole fuses, or double-pole incandescent sub-main switches with double-pole fuses, as the case may be. The arc circuit regulating resistances are mounted upon angle-iron frames ten inches clear of walls, and behind or conveniently near to the respective switchboards.

INTERIOR OF GRAND AVENUE (LOOKING WEST).

The various sections of the Exhibition are lighted by means of Brockie-Pell 10 amp. arc lamps of various types and incandescent lamps of various powers. In the main buildings the arc lamp is adopted for general lighting, running

GLASGOW INTERNATIONAL EXHIBITION:
PLAN OF BUILDINGS AND GROUNDS.



ten lamps in series on a 500-volt system; for all other buildings the arc lamps are run five in series on a 250-volt system. Generally speaking, the arc lighting is calculated and arranged on the basis of 750 sq. ft. of floor space for each 10-amp. arc lamp. The general height from the floor level to the centre of arc in the main building is 23 ft., and in other buildings about 12 ft. The wiring of these arc lamps is so arranged that every alternate lamp is connected to a different circuit, so that in cases where a particular lamp or circuit happens to get out of order the general lighting of that portion of the building will not be seriously affected. In addition to the arc lighting of the main buildings there is also a complete pilot system of incandescent lighting, arranged so that all the principal passages, etc., can be lighted direct from the Corporation supply. The main cables, which are supplied and laid by the British Insulated Wire Co., Ltd, Prescot, are low-tension triple-concentric cables, Class A, insulated with impregnated paper and lead-covered. These cables are seven in number, each having a sectional area of inner copper conductor of ·25 sq. in. and over-all diameter of 1·73 in., and are laid in a wood conduit beneath the flooring, between the main switchboard and the various sub stations and switchboards, the total length being about 4,000 yds. The lead coverings of these cables are metallically connected together at several points and the whole are connected to earth. The voltmeter pilot wires are also lead-covered, and run in the same conduit as the main cables.

The branch main cables and sub-main cables, also supplied by the British Insulated Wire Co., are laid in wood conduits beneath the flooring, or run overhead, fixed upon insulators between the sub-switchboards and the distribution fuse-boards.

The arc circuit cables for the main buildings are supplied by Messrs. Frankenburgh Ltd., Salford, and run overhead between the distribution fuse-boards and the various lamps, resistances, switches, etc., fixed upon insulators or enclosed in wood casing or iron tubing, according to the nature of the particular section. The incandescent wires are run between the distribution fuse-boards and the various lamps, switches, etc., enclosed in wood casing or iron tubing.

A searchlight, supplied by the British Schuckert Electric Company, is erected on the dome of the Grand Concert Hall. It is fitted with parabolic glass mirrors 1,500 mms. in diameter, and the lamp and equipment are regulated by two small electric motors. The electricity working the searchlight is taken from the Corporation supply—85 amps. at 500 volts, and transformed to 150 amps. at 110 volts, the pressure required for working the light.

It will thus be seen that, while this is not specially an Electric Exhibition, electricity forms a very important part of it. Four-fifths of the power developed in the Boiler House will be converted into electricity, and there are, besides, some 50 or 60 electro-motors driving exhibits direct. Extremely interesting and important are the sections devoted to locomotives, driving machinery, labour-saving machinery, marine engineering and shipbuilding; but these can only be named in the present article.

B. T.

NOTE.—The exhibits at the Glasgow Exhibition will be described and criticised in a series of articles by experts in each department, for example:

Electrical Engineering	*Sydney F. Walker, M.I.E.E.*
Textile Machinery	*Jas. Wade.*
Machine Tools	*John Ashford, A.M.I.M.E.*

Etc., Etc.

Textile Testing and Testing Machines.

By GEORGE R. SMITH,

Late Lecturer and Demonstrator on Carding and Spinning, Yorkshire College, Leeds.

MR. SMITH is well known to those engaged in teaching spinning, as it is his passionate desire to see spinning so taught experimentally as to retain the individuality of the student.

Mr. Smith first went through the various processes of spinning as a workman, then quitted it for teaching science and spinning; after a time he again returned to works as a foreman, and again quitted them for a college course in Engineering. He then began to lecture on spinning at the Yorkshire College—a newly-formed subject. This gave him time to take up private professional work, which has steadily grown until he relinquished his college work just before the commencement of this session.

Mr. Smith's experience with spinning machinery, especially with drying and testing textile materials, places him at the front as an expert in this kind of work. Mr. Smith is the author of a class text-book, entitled "Practical Mechanics for Textile Workers." He has also contributed several papers to learned societies on Textile matters.

THE subject of testing the strength of materials in the textile industry is not quite a new one. Tests have been made, and are applied by the Government to cloths for the Army and Navy. The results of these tests have not always been satisfactory to the people concerned, on account of the errors which are liable to creep in owing to the present method of testing. The sources of these errors will be set forth in the description of a new form of cloth-testing machine. The first part of this article deals with the strength of threads, because for the manufacturer to know the strength of cloth he desires to make from any mixture of raw material, he must first ascertain the strength of the thread he can produce from the same. There is no reason why he should not be able to foretell with reasonable accuracy the strength of a thread made from any mixture of textile materials, and from the strength of this thread be able to determine the strength of the cloth he intends to make.

Under the present conditions of working the blend maker requires a large number of years of experience, as well as considerable ability, to be able to mentally gauge the strength of the yarn he intends to make from the mixture of material he is considering. He may have been making blends out of which some workmen would produce a thread 10 per cent. stronger than that he himself may have produced. His own workmen may at times produce threads of exceptional strength from blends which at other times only yield threads of medium strength. There may be many reasons for such a variation in strength of the spun material, which are not due to the variation in quality of the raw stock, but entirely to the skill exercised and the working condition of the machinery at the time. With a systematic method of testing and recording the results, as suggested below, the blend maker would know from day to day how near or how far each blend was from yielding the results expected from it.

With such a collection of reliable data about blends, the blend maker would soon know what effect an alteration in one of the elements of a blend would

produce. The high value of such knowledge cannot easily be gauged, for nowhere does such definite knowledge exist. Now suppose such a system to be installed in works, and that there are no young members of the firm to take it up. A youth might be easily obtained who would make it his duty to glean and record all the information given in the table below. He would present from day to day, if required, his average readings, either in tabular form, as shown, or in the form of curves, so that the fluctuation of the efficiency of the process of manufacture might be seen at a glance. If such supervision was thought unnecessary he would take the average of his daily observations and enter them in such a form that the blend maker might easily compare his blends and the results obtained from them.

Date. June.	Name and No. of blend and Machine.	Counts. Carded.	Counts. Spun.	Breaking Strength	Stretch on 60".	Diameter of Thread. Free.	Diameter of Thread. 50% of Total Stretch.	Twist in Thread.	Weight Efficiency of Blend.	Remarks.
2										
3										
Averages . .										

With the exception of column 3 this table will serve for cotton and worsted, while the whole table is suitable for the woollen industry.

Before proceeding to consider the value and the utility of the data named in the above table, it will be well to examine the machine on which this data is to be obtained.

Fig. 1 represents an elevation and Fig. 2 a plan of the working parts of a machine for testing the strength, strain, twist, shrinkage due to twist on a thread 60 ins. long, and the relative quantities of material to produce a twist thread.

Before commencing a test, balance the beam which turns on knife edges *X* by means of the large balance weight *Y*, and give the final adjustments by means of the small weights *Z*. Now that the beam is balanced, its weight may be considered to be eliminated.

Fix one end of the thread to be tested under the jaw *A*, over the edge *B*, and over the peg in the open jaw *C*. A small clip is now fixed to the loose end hanging through the jaw *C* while it is at zero on the scale *I*. This clip is to produce the same initial tension on all the threads tested, so that the diameter, stretch, and twist in threads are always measured under the same conditions. Now close the jaw *C*, remove the initial tension weights, and the thread is now ready to undergo the test.

To start the test, furnish the beam to swing freely on its knife-edges and start the clockwork motor, by means of which the jaw *C* is drawn back from its zero position by the screw *D*. As the thread does not stretch without a load being applied to it, the load beam is tipped by the pull in the thread under tension.

The left-hand end of the beam moves up, carrying with it the pad *E* which covers the end of the pipe *F*. Water now flows from this pipe into the bowl *G*, down the tube *H*, into the graduated vessel. This water presses down the long end of the beam and produces a stress in the thread, which strains it a little. This lengthening of the thread allows the left-hand end of the beam to fall, consequently the pad *E* again covers the nozzle and prevents further flow of water into the graduated vessel. As the clock motor *M* is drawing back the jaw *C* at a constant rate the beam tends to tip and slightly reduces the pressure at the end of the water pipe, and water runs gently into the graduated vessel until the load thus applied stretches the thread again, and so the operation goes on until the thread breaks. The experimenter then stops the motor and reads off on the scale *I* the amount that the thread has stretched to the nearest one-hundredth part of an inch.

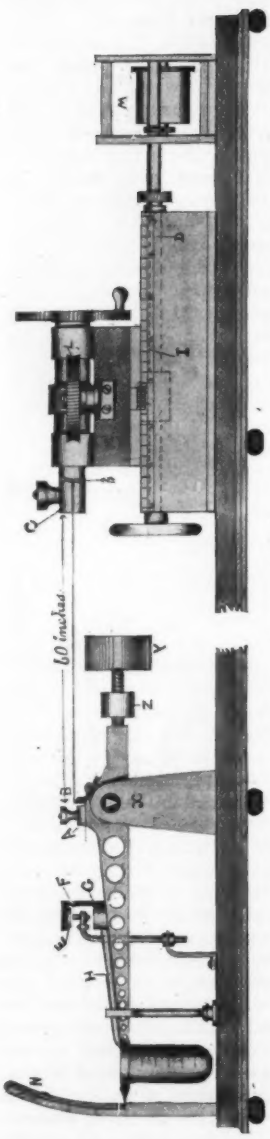


FIG. 1.—ELEVATION.

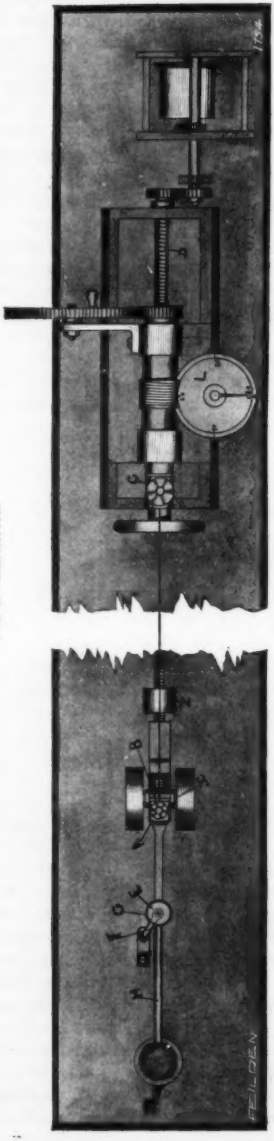


FIG. 2.—PLAN.

DETAILS OF TESTING MACHINE FOR THREAD 60 INCHES LONG.

As before mentioned, the load is applied to the thread by running water into the graduated vessel at the end of the lever. This graduated measure shows the number of ounces or grams of water run into this measure, but the amount so read off does not indicate the load on the thread but only one-tenth of the load, because the beam is made to magnify the load shown in the graduated measure ten times. Though the beam appears straight it is really a bell-crank lever, as shown by the dotted lines in Fig. 3.

The arm *CA* is ten times the length of the arm *A B*, consequently one ounce applied at *C* is equivalent to a pull of ten ounces at the thread *X* or the point *B*, and for the same reason the movement of the point *B* or the point *X* by one-tenth of an inch would cause the point *C* to move one inch. This circumstance is taken advantage of to measure the shrinkage of a thread due to the twist put into it. This is done by causing the pointer placed at *C* to move over the scale shown at *N*.

The amount a thread will stretch before it breaks is generally taken to

indicate the high quality and the holding power between the fibres composing the thread, while the load it will bear is considered to indicate the quality of the material of which it is composed as well as the evenness of the thread.

The diameter of a thread may seem unimportant, but it is really necessary, and is valuable information when considered in conjunction with the counts of the yarn, for at the same time that it indicates bulkiness of the thread, it to some extent indicates quality due to the manufacturing operations.

Without such measurements it would not be easy to make an absolute record of any important alteration of one of the fibres together. The effect of each of these factors can be observed through the microscope.

A person with a memory for form, *i.e.* who could remember the appearance of a thread, would quickly detect a change in the diameter of the thread due to an alteration of the thickness of the fibres, their number, or axial arrangement; consequently he could find the cause of bulkiness of a thread, because, in the first instance, he would observe all threads under the same tension, and as near as he chose under the same amount of torsion. This power of analysing threads should prove useful not only in connection with the every-day processes of manufacture,

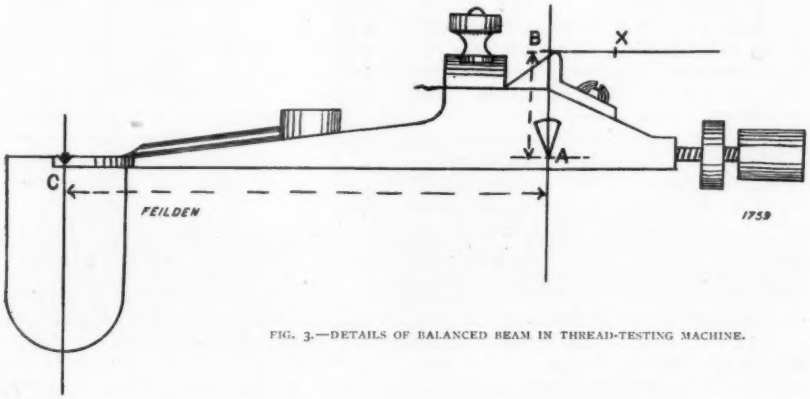


FIG. 3.—DETAILS OF BALANCED BEAM IN THREAD-TESTING MACHINE.

elements of a blend, or increased or decreased foodiness of the thread due to superior skill in the manufacturing processes.

At the same time that the thread is measured it is seen magnified about twenty times as it lies across the glass scale in the eye-piece of a microscope by which its diameter is measured.

Now the diameter of a thread depends upon five factors, viz., thickness of the fibres of which it is made, the number of fibres, their axial arrangement, their natural elasticity with which they resist compression by the torsion in the thread and the tension on it, the load stretching the thread and the twist which forces the

but by providing means for tracing some of those obscure causes of faulty cloth.

The tension in a thread is a very important factor in connection with its diameter. Threads which are bulky when not under tension and draw into small threads when loaded, are made of elastic material. Consequently, if the diameter of the thread is measured when loaded with the initial tension weight only, and again when loaded to such an extent that the thread has stretched 50 per cent. of what it will stretch, this reduction in diameter, due to the load applied, is a measure of its natural elasticity. A still better way of measuring the reduction in diameter of the thread, due to the load

applied, is to watch the thread pull down —*i.e.*, grow smaller—through the microscope as the thread slides under the scale in the eye-piece of the microscope, which is graduated in thousandth parts of an inch.

The twist in the thread is best found by taking out the twist in the thread by rotating the jaw *C*. One revolution of the wheel *L* represents two turns per inch, while another wheel, not shown, indicates the turns per inch in the thread. Now the number of turns per inch in a thread is not only important in judging the elastic quality of the thread, but it is desirable when wishing to produce the same character of thread with reference to its strength and stretch.

The weight efficiency is a term used in this table to indicate how much per cent. of the original blend of raw material has been converted into spun thread. This term can only be found when each blend is finished. It is a very important term because it shows to some extent the skill and attention exercised in the manufacturing operations. This efficiency would be found by dividing the weight in pounds of the spun thread in the grease by the weight in pounds of the blend unworked in the grease. If this answer be multiplied by 100 the efficiency will be expressed as a per cent. of the original weight.

The last column is for remarks on the appearance of the thread or any other remarks the experimenter may deem desirable to record, so that it can be compared with other threads.

The advantage accruing from testing the strength of materials has hitherto been considered only with reference to the blend maker. He is not the only man who should test to obtain information. The foremen who have the responsibility of making good threads should test to discover what effect each alteration produces, and out of such a store of information obtained find what are the best conditions for producing excellent work. No doubt many clever and skilful workmen will scout the idea of supplementing their excellent judgment by what may be termed a mechanical aid. However, to those less biassed this method of obtaining information and confirming their judgment is worth the trouble required to obtain it. What warp spinner can say, so far as his unaided judgment will permit, that he has the correct amount of twist to yield a maximum of strength, at the same time that the thread yields the other qualities desired? It is not an uncommon thing for dealers in warps to order the turns per inch that are to be put into a particular class of warps ; and why should they not require the warp to reach a given standard of strength? A thoughtful and clever spinner would make it his duty to test a thread or two on starting a frame, and while the thread is in the testing machine increase or decrease the twist to ascertain what effect it has on the strength and appearance of the thread. A stock of such private notes, with the experience gained by obtaining them, should enrich and strengthen the judgment, and thus enable a man to produce better work.

The cotton spinner is much akin to the woollen and the worsted spinner, and out of the remarks on these branches of spinning he will find what applies to himself.

The woollen mule is a beautiful piece of machinery, not entirely on account of the evolutions it will perform, but partly on account of the fine adjustments and number of alterations that can be made in it to produce different effects.

At present it is not known to what extent each alteration affects the strength and the character of the thread, nor does the spinner know to what counts the blend should be carded to yield a thread of maximum strength. He has a notion that the carded thread should be of such counts to yield a spun thread of such counts, so that the waste in spinning is a minimum and the strength a maximum. While these notions are unsupported by facts obtained by testing, he has to be content with those counts the condenser happens to yield, which may or may not be just what he would like.

For each class of material there must be a limit to which the material can be reduced in thickness by drawing in the mule to yield the best possible results. As to what this limit is, the spinner can

find only by experiment, and by testing the spun thread before and after the alteration. By this test he knows how his alteration has affected the material being spun.

It frequently happens that a blend spins badly when, if not drawn quite so hard, it might spin well. The question naturally arises. How does this hard drawing affect the strength. Does the increase in the strength or appearance of the thread compensate for the waste and loss in output caused by hard drawing? This question cannot be answered in a general way, because the character of blends vary so much, as well as the nature of the carded thread. However, each spinner can find out for himself by frequent testing before and after each alteration what is the best course for him to adopt.

It frequently happens that in the manufacture of cloth for ready-made suits that two threads are twisted together to produce one strong enough to bear the stress put upon it during the weaving of the cloth, as well as to make it wear better. In the higher class cloths, such as the West of England cloths or Scotch tweeds, this cotton thread is replaced by a silk thread; but in these cases it is chiefly for effect in the woven fabric as well as strength.

Now rules are given in class text-books for finding the resulting counts of two or more threads when twisted together. These rules are very good for academical work, and serve to give a rough idea of the counts that may be expected when threads are twisted together. These rules are not so complete as one would desire to see them, as will be seen from a little consideration of the following rule, which is used to find the resulting counts of a thread produced by twisting two threads together of known counts:

"Multiply the counts of one thread by the counts of the other thread and divide by the sum of these counts."

It will be observed that no notice whatever is taken of the amount of twist put into the threads to bind them together, nor is their relative rigidity or diameters considered.

Now it must be clear to all, that the greater the number of turns per inch the lower will be the counts, because there will be a greater length of yarn per inch. Again, if one thread is hard and stiff, while the other is soft, the soft thread will bend easily round the stiff one, and a greater length of soft thread will be required than of the hard one. If their diameters are unequal, and the counts the same, different lengths of each yarn will be required.

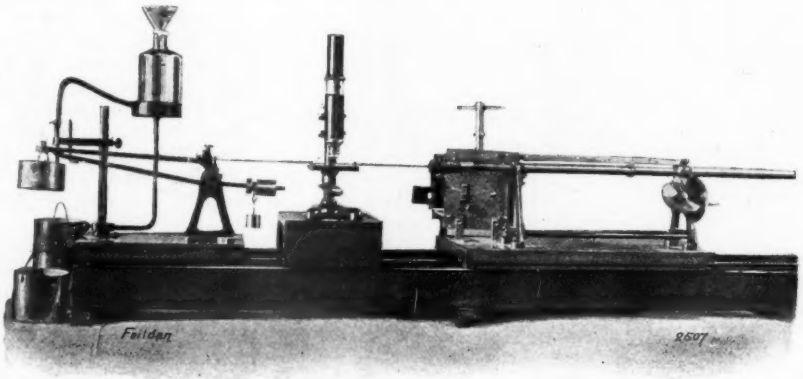


FIG. 4.—GENERAL VIEW OF YARN-TESTING MACHINE, SHOWING MICROSCOPE ATTACHED.

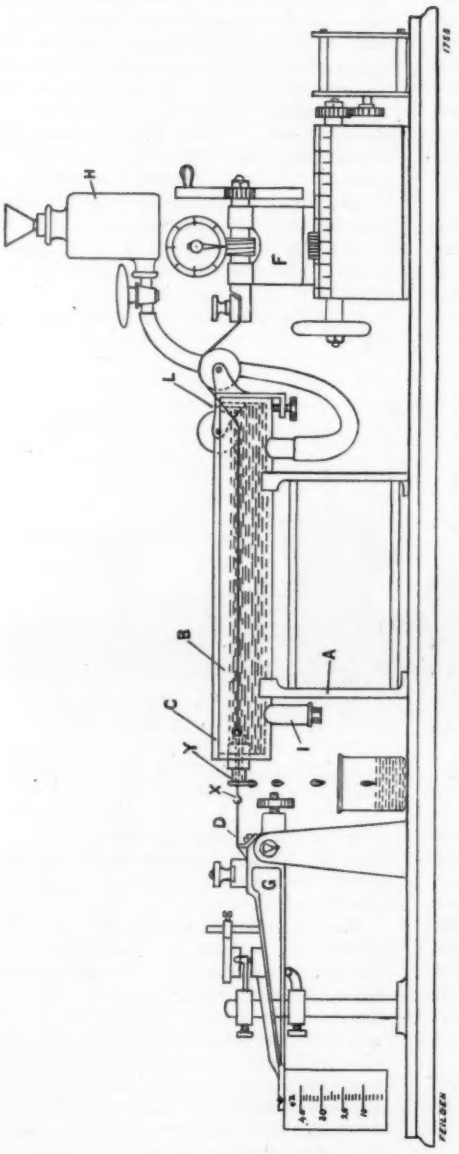


FIG. 5.—DETAILS OF COTTON THREAD-TESTING MACHINE.

The relative length of yarns in a twisted thread is an important factor when the cost of yarn is considered, and so is the twist when the strength is considered. There are, no doubt, general laws which might be applied to each of the above cases, but at present nobody knows them, because, hitherto, no apparatus has existed sufficiently delicate by means of which they could be discovered.

These general laws are not of such practical value to the twister of yarns that special rules are which apply to his own particular class of work. By repeated testing under different conditions, and with different classes of material, the twister would quickly learn the practical rules underlying his work, and thus be able to find by experiment or by calculation what counts such and such material would produce or be required to yield a twist thread of given counts.

It may be of interest to many readers to know that the thread, hank, and cloth-testing machines were designed to meet the requirements of the managing director, Mr. Henry Grandage, of Low Royd Dye Works, to be used in connection with the bleaching, dyeing, and mercerising industry. Mr. Grandage being a scientifically trained man, it naturally occurred to him that it would be an advantage to have a record of the strength and character of the warps and hanks purchased, also corresponding information after being bleached or mercerised.

How to make the fine measurements necessary for this kind of work was a difficulty, but it has now been surmounted in such a manner that an exceedingly small alteration in strength or change in character of the thread can now be recorded with

absolute accuracy on this yarn-testing machine. Fig. 4 gives a general view of yarn-testing machine, with microscope attachment for examining the condition of the material at different stages during its test. Fig. 5 represents the machine, described in Figs. 1 and 2, adapted for research work on bleaching and mercerising certain branches of dyeing and drying in these works.

Among the many things it is desirable to know in connection with the mercerising of cotton which can be found by using this machine are the exact effects of time, tension on the thread, twist in the thread, strength of acid and drying under various amounts of tension. In connection with drying and bleaching there is the question of tendering. All these questions are of great importance to those who would lead in these branches of industry.

A in Fig. 5 is a stand for supporting a semi-circular trough *B*, which may be covered with a glass plate *C*. At one end is a pair of pulleys clamped to the end of the tube as shown. In the other end is a cork through which is passed a glass tube with a hole a little larger than the platinum wire hook which goes through it. The hook *X* is coupled to the beam by a fine wire *D*. The length of

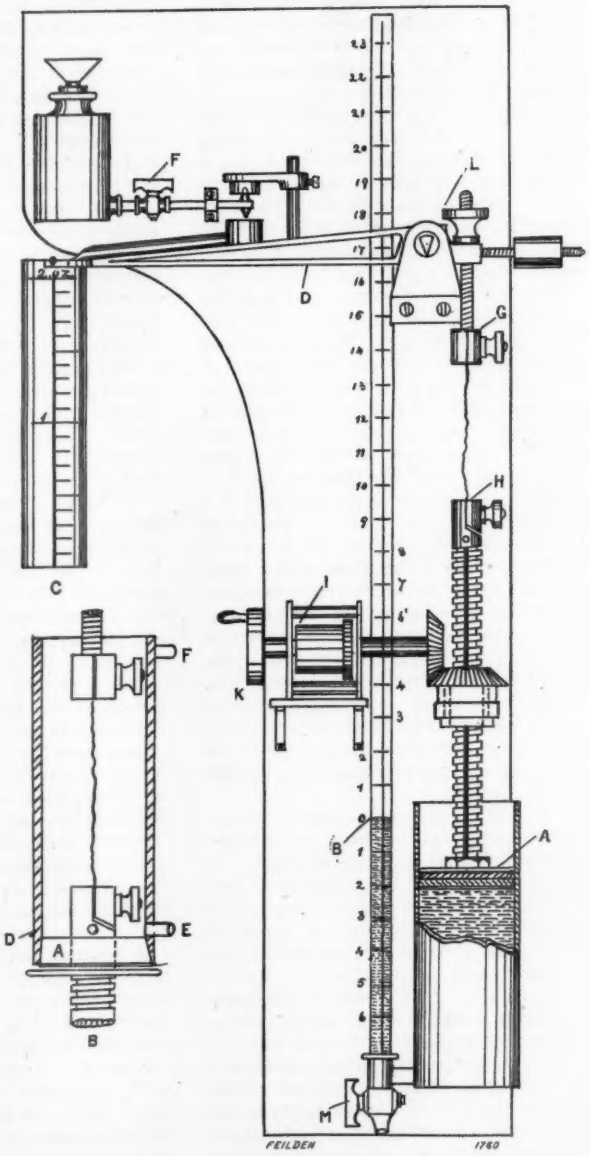


FIG. 6.—MACHINE FOR TESTING WOOL FIBRES AND SHORT THREADS.

FIG. 7.—SPECIAL ATTACHMENT FOR TESTING MACHINE.

the thread under treatment and test is preferably 30 ins. long, while that portion going over the pulleys is thick silk, so that all the stretch recorded comes from the material under test.

Having got the thread fixed in the trough *B*, which during the time of fixing of the thread is empty, take out or put in twist (if an alteration in the amount of twist is required) while the thread is slack. Now set the sliding head *F* so that the pull in the thread just makes the balanced beam *G* float.

The test may now start by filling the trough *B* with bleaching liquid or acid from the bottle *H*. When the acid reaches the level of the small tube *Y* it begins to run out of the trough at the same rate as it enters. If the liquid is allowed to run in just a little faster the material becomes well covered with liquid.

When the thread has been under treatment long enough, place the bottle *H* at a lower level than the tube and the liquid runs back into the bottle. If it is to be tested when dry, couple the tube *I* with some source of air at the required temperature it is proposed to dry at, and pass this air over the thread until it is quite dry. A thermometer placed at the outlet by the pulleys *L* will record the temperature of the air surrounding the thread. When absolutely dry the test can be made. Absolute dryness is desired so that the test can be repeated under the same conditions.

It should be observed that the thread may be under any amount of tension while in the liquid or during drying.

The microscope for measuring and examining the thread is not shown in this drawing, but it is mounted on a pair of rails so that it slides the whole 60 ins. over the glass trough.

Very little has been done in the shape of research work in the spinning branch of the textile industry, whereas in each of the many branches of this great industry the field seems almost boundless. What progress has been made seems to come almost entirely from inventors and makers of textile machinery. This is a lamentable state of things, considering to what extent other industries have benefited by scientific research. What little research work has been done on fibres and threads has been done by Dr. Bowman and recorded in his book on the wool fibre. In order that this good work may be continued under the most favourable conditions for observing effects, the machine which is shown in part in Fig. 6 has been designed.

This form of machine is suitable for wool fibres and short threads. The extensions of the thread or fibre are magnified 100 times by the movement of the column of water in *B*, which is produced by forcing water from under the piston *A* into the pipe *B*.

The weight or load is applied to the thread or fibre in the manner described above, but the vessel *C* at the end of the beam is small in diameter and long to obtain fine readings of the quantity of water it contains.

To make a test with this machine first balance the beam *D* by means of the weight *E*, while the water-tap *F* is closed. Now fix the fibre in the jaws *G* and *H*, providing *H* is high enough. If it is not high enough, throw the spring motor *I* out of gear and raise it by means of the hand-wheel *K*. By means of the thumbscrew *L* put sufficient tension on the fibre to just make the beam float. Now observe the height of the water in *B*.

Begin the test by starting the spring motor *I* and opening the tap *F*. The motor depresses the piston by turning the bevel wheel which is screwed on the inside. This depression of the piston and the head *H* causes the fibre to stretch, because the beam remains stationary, which is due to the load at one end being equal to the pull at the other or short end of the lever.

If the material stretches much the water in *B* will quickly rise to the top of the tube. When it has done so, stop the motor and draw down the water in the tube *B* to the level marked *O*, by means of the tap *M*. Then let the test go forward until the water reaches the top of the tube again. Stop the motor and draw the water down to the level *O* once more and again proceed with the test. When the fibre has broken add the number of inches together that the surface of the

water in the tube *B* has travelled through; this number represents the number of one-hundredth parts of an inch the fibre has stretched.

One-tenth of the load required to break the thread is shown by the number of ounces in the glass vessel *C*. The microscopic attachment is not shown, but it merely consists of an arrangement for making the instrument slide vertically over the length of the thread or fibre under test.

Fig. 7 shows a special attachment, and consists of a tube surrounding the thread, so that the thread may be immersed in air or liquids at any temperature. *A* is a nut working on the screw *B*; this nut is surrounded by an elastic band *C*, which enables a good fit to be made between the tube *D* and the nut *A*. *E* is a tube by which air or a liquid can be admitted to envelop the fibre or thread, while *F* is an exit for a liquid when one is used. To use this attachment, cause the nut and tube to slide down the screw thread, so that the fibre can be fixed in the jaw standing out of the tube. Fix the other end of the fibre in the top jaw, and rotate the tube until it slides up and covers both jaws. The test may be then carried out as described above.

It is well known among textile people that the cloth purchased by the Government for the Army and Navy must reach a minimum standard of strength, This is one of the best means that can be adopted for keeping up its quality, and at the same time allowing individual manufacturers liberty to obtain this strength either by a high quality of material and inferior skill, or by using superior skill and a rather lower quality of material. It is a well-known fact that superior skill alone in the scribbling and spinning department will frequently increase the value of a thread by 10 per cent. of its original value, and this increase in value of the thread does not represent the total gain to the manufacturer.

The buying and selling of cloth partly on the strength test, as carried out at present by the Government, is not always satisfactory to the parties concerned, because of the unreliability of the present methods of testing. As an example of the want of confidence in the present method of testing the strength of cloths the following remarks may be of interest. They are given as they were told to me by a most trustworthy manufacturer. He said: "I sent three pieces of cloth to three different places to be tested. I expected these pieces yielding about the same result, but found them to differ so much that none of them could be relied upon." I have myself watched an experienced experimenter obtain by testing, as inexperienced people would test, worsted cloth specially woven for the purpose results which varied 15 per cent.

Now this machine is designed to prevent the experimenter from obtaining other than correct results when testing the same cloth, either at the same or widely different times. As will be seen, this is a gravity and not a spring machine, consequently it is independent of a variation in temperature and not liable to deteriorate at the same rate as a spring machine. In respect to capacity or range of work the machine will take, it is very unlike the spring form of testing machine, as it will test with superior accuracy any textile material, whether it requires a pull of 5 lbs. or 1,000 lbs. weight to break the material under test.

The machine shown in Fig. 8 is suitable for testing either hanks of cotton or worsted, or cloth from 1 in. to 26 ins. in length.

This patent form of holding the hank possesses one great advantage, viz., that each thread in the hank is under the same amount of tension during the test, because the threads are not on the top of each other and are not allowed to slide over each other. Consequently, there is no tendency for a hank to break down a thread at a time.

A is the jaw of the machine suspended from the pillars *B*. This jaw is connected to the beam where the load is applied by means of the links *D*. The beam is carried on ball bearings *E*, because the turning of the beam on its bearings is so small that they are practically equivalent to knife edges. *J* is another jaw which slides easily along the rods *J* so as to accommo-

date specimens of any length. The yoke and jaw are drawn back by the screw *O*. This screw is driven by the worm-wheel *R* from a reversible electric motor, belt pulleys *L*, or hand-wheel. *V* is a scale for measuring the stretch of the material to the nearest one-hundredth of an inch, and *T* is a scale on the water vessel of the beam for measuring the pounds and fractions of a pound of load applied to the material being tested. It should be observed that where the electric current is not available other means of driving may be adopted.

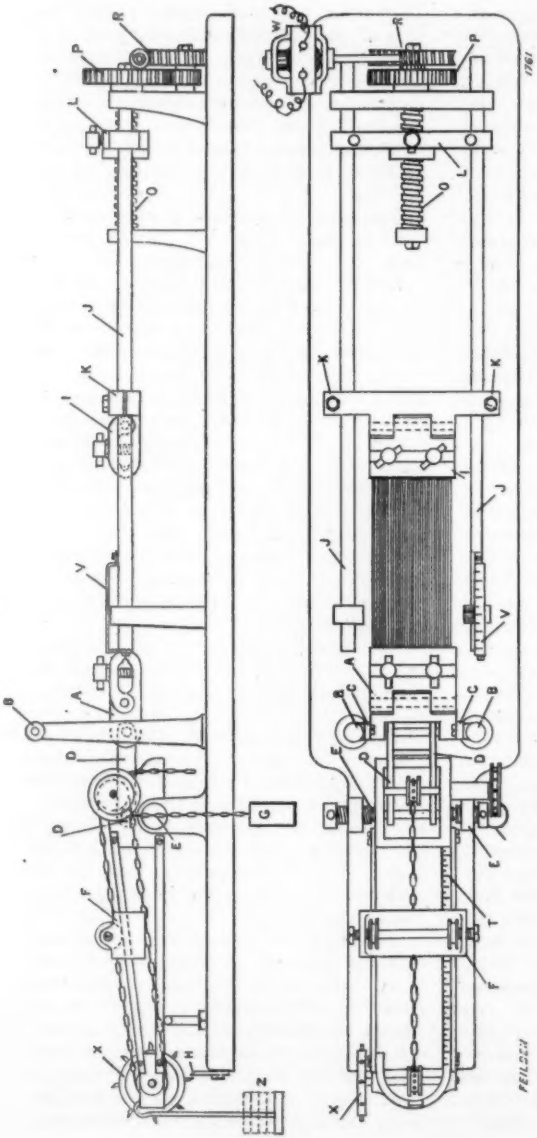


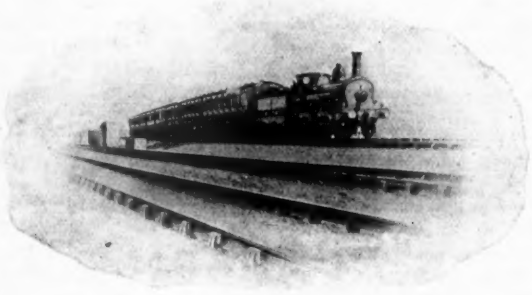
FIG. 8.—DETAILS OF MACHINE FOR TESTING HANKS OF COTTON OR WORSTED CLOTH, ETC.

To use this machine, remove the water vessel, and see that the beam floats or rocks with the lightest touch possible. Now fix the cloth in the nip of the jaw *A*. Reverse the direction of running of the motor so that the jaw *I* is carried to the left by the screw *O* working in the yoke *L*. When the yoke has travelled until the two jaws are six inches apart the scale *V* is at its zero position. Clamp the cloth in the jaws, see that the beam floats freely when it is unloaded, and read the position of the scale *V*; then the trial is ready to start.

Start the motor in the right direction and note from time to time as the test proceeds how much the material has stretched for every addition of a few pounds of load up to the time the material breaks. From these results the stretch and breaking load will be seen, also at what load the material ceases to give equal extensions for equal loads applied. This is, perhaps, the highest test of the quality of a cloth that can be applied to it.

A worsted or cotton hank of yarn is tested in

a similar manner, but the fixing of the hank in the same jaws is performed differently. The hank to be tested is spread evenly by means of a comb over a vulcanite rod seven inches long; this rod is then placed in the jaw and the jaw closed, but not nipped tight. The other end of the hank is similarly placed on a vulcanite rod and laid in the other jaw, which is partially closed. A little tension is now applied to the material under test, which pulls the rods into the recesses made for them in the jaws, as shown. The jaws are now firmly closed and the jaw *I* runs back until the beam just floats. During the period the beam floats, the mouth of the bent pipe is uncovered by the rubber pad *Z*, and water flows from the vessel *X* into the vessel *T*. The weight of this water in the vessel *T*, through the medium of the beam, produces a pull in the links *D*, hence on the specimen under test. As the material ceases to require a load to stretch the specimen, the end *Z* of the beam settles closer to the top of the bent-tube and so reduces the flow of water into the vessel *T*. When the specimen does not require a load to stretch it, no water flows into the vessel *T*. Hence the quantity of water in this vessel represents the breaking load as shown on the scale.



Electrical Fires.

By WILLIAM BREW, A.INST.E.E.

(Continued from page 334.)

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DISTRIBUTION BOARDS.

THE distribution centre system of wiring has come very much to the front during the last few years, in fact to the almost total exclusion of the tree system, except in special cases and small installations. An inspection of the distribution boards manufactured at the present time shows a great improvement in design and attention to detail.

The modern boards, in addition to being split or divided into two halves for + and − wires respectively, have the slate panels mounted on porcelain bushes or insulators, thus separating the slate from the supporting battens or metal frame of the board.

These precautions might seem at first sight a little superfluous perhaps, but the extended use of slate as a cheap and suitable material upon which to mount electrical fittings has established well-known facts concerning it, and a point which must be guarded against in employing slate as a base for fittings is the use of conducting qualities or material possessing metallic veins which will sometimes allow a considerable current to pass through it, and render the insulation between circuits and the earth very poor.

Thus it is that in an installation with its main switches mounted on slate bases, it is possible to get a slight shock from the wiring to earth, although the switches on both poles are off. Again, on testing an installation where slate bases are employed on the main switches or fuses, the test may be quite unreliable unless the house cables have been previously removed from their terminals, owing to the pressure of the supply being communicated by means of the partly conducting slate bases to the house wire terminals and upsetting the indications of the testing set or ohmmeter employed. The writer has frequently found this to be the case. This possibility of leakage through the slate is mainly responsible for the rules we have insisting that our distributing boards shall be split. There is, however, another very important advantage to be gained by separating as completely as possible the main bus bars and their connections—*i.e.* the avoidance of accidental short-circuiting with a screwdriver or other metal tool at the time of replacing a fuse. Such a short circuit between the bus bars is always accompanied by more or less molten metal falling about, and may readily set fire to anything inflammable in its neighbourhood. The employment of a separate case for each bus bar obviates this danger, but is sometimes inconvenient as regards wiring.

The faults with distributing boards at present are not so often due to the manufacturer, who turns out well-designed boards, as to the wiremen who erect them, and the subsequent wiring work frequently renders superfluous all the care and detail which have been lavished on the board itself. It is in the wiring work at the back of the board, and covered up, that faults generally occur. It seems not a little inconsistent in this respect that some rules should be so emphatic as regards + and − wires being separated in casings, and not allowed to cross one another at T-joints and other places, and yet ignore a distribution board at the back of which the + and − circuit wires are all bunched together in a wooden box which is not damp proof or nail proof, and decidedly inflammable. Unless a distributing board is mounted in a fire-proof metal case in conjunction with a pipe-system of wiring, the greatest care should be taken to separate the + and

– circuit wires at the back. This is, after all, a simple matter, and can be readily accomplished by the method of wiring indicated in the diagram (Fig. 14), where the + wires pass at the back of the slate to the lower bus bar, and the negative wires are taken to the top terminals over the front of the slate.

The diagram, Fig. 15, shows the connections at the back of a distributing board of faulty design sometimes met with. In this case the + and – circuit wires cross over one another even before being protected by the fuses, and any abrasion of the insulating material upon them would cause fierce arcing at the back of the board, and a serious fire would probably result. Moreover, the abrasion of the soft insulating material on electric light wires often occurs when least expected, not only from carpenters' nails and the attacks of vermin, but sometimes as the result of subsequent fixtures, such as blind cords and the hidden metal rods for opening skylights, etc. Some porcelain fuse bases readily adapt themselves to the making-up of fuse boards where the number and current capacity of the circuits is not too great. Fig. 16 is an example of this, the bus bars being supported by one set of terminals of the fuse bases, and the whole being fitted into an insulated conduit box, forms a capital fuse board. In this case, with conduit work and a metal containing-

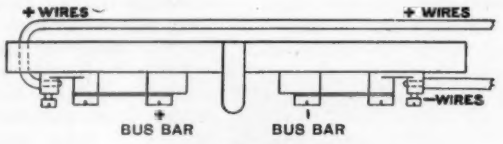


FIG. 14.

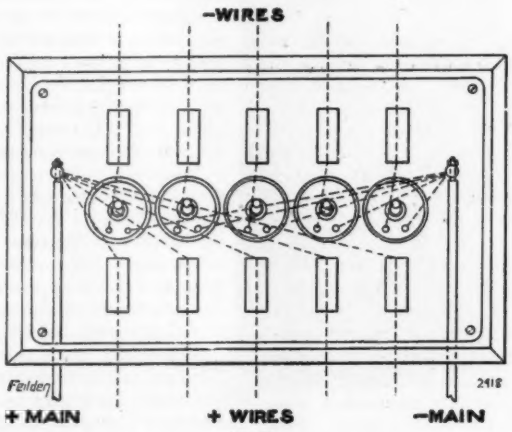


FIG. 15.

case for the fuse board, little objection can be urged to the circuit wires touching one another at the back of the board, and each will be protected by its fuse at the bus bar. With heavy current branches, however, they should undoubtedly be separated, and, in addition, the + and – wires should be drawn into separate tubes.

A most important point to be observed with distribution boards is that the connections of the main cables and branch circuits are thoroughly sound, and it must

be remembered that great heating will eventually result where loose contacts occur, causing oxidation of the metal at the contact surfaces, which augments the evil and may run the solder out of the cable thimbles and produce serious arcing. It often happens in this respect that fuses are melted by bad contacts at their terminals or those of the cable, resulting in the replacement of the fuse bridge by a heavier one by an inexperienced person, which may then render little or no protection to the wire of the circuit, and be a great source of danger. It is often very difficult in such cases to guard against the insertion of a heavier fuse bridge, and cases have come under the writer's notice where fuses repeatedly melting from bad cable contacts had been replaced by heavier ones, until the wires they were supposed to protect would have been exceedingly hot before the fuses melted under normal conditions. Insurance rules often specify that all connections must be made on the front of the distributing board. This is of great importance, and if it is carried out loose or imperfect contacts can at once be detected by feeling the connections with the fingers shortly after the current has been switched on to the circuits, care being taken whilst doing so to stand upon dry wood or other insulating material to avoid shocks, for if the installation be fed from one side of a three-wire system of supply, the middle wire is now generally earthed, and, consequently, one pole of the consumer's installation also, and shocks of 220 volts under these circumstances are not pleasant.

SWITCHES.

Many fires have originated from the use of flimsy and imperfect switches, and the function performed by a switch in an electric light installation is of such importance that it may be advisable to discuss it at some length; this we may conveniently do under the following heads:—

(1) Mechanical design.
(2) Conductivity of contact surface and bridge piece or lever.
(3) Connections to terminals.
(4) Insulation of parts.
(5) Length and nature of break.

(1) Too much stress cannot be laid upon a switch being thoroughly sound mechanically, whether for use upon a branch or main circuit; a switch has necessarily moving parts, which are generally subject to all kinds of rough usage, and faulty screw threads, flimsy springs and pivots, are bound sooner or later to become deranged with possibly serious consequences. Unfortunately this is a point which is at once directly opposed to cheapness, and with cheap installation work we must inevitably look for flimsy switches. The fewer and more solid the working parts about a switch the better, and particular importance should be placed upon a positive connection between the contact-making bridge or lever and its actuating handle; in some switches we find the throw-off of the lever entrusted entirely to a spring released by the handle, but practice has shown this type to be unreliable, and if the contact surfaces become rough from sparking after some usage the bridge piece is held effectually between the contacts, and the switch cannot be opened without first removing the cover.

Insurance rules sometimes specify that the switch mechanism must be such that the contact lever is either fully on or fully off in order to prevent tampering by the uninitiated. This rule can be complied with, and the work of opening and closing the switch mainly entrusted to a spring in a well-designed switch of small current capacity, and more readily so, if precautions are taken to avoid the roughening of the contact surfaces by means of carbon points, which always make contact before and break circuit after the main contact lever. Fig. 9 (illustrated in March issue) is a photograph of a double-break switch which has such carbon contacts.

In larger type switches, however, the work of making perfect contact is generally too great to be entrusted to a spring, which then usually comes into action at the instant of throw off, only to ensure that the break is quickly accomplished. This type of switch is much used on the continent and in various forms in this country also, and it is important to notice with switches generally that the spark at making contact is almost insignificant, and that

with switches on normal circuits of 100—250 volts no spark will leap across any but a microscopical gap between the contact surfaces; there is however, this about it, that the movement of the switch lever must in all cases be brisk to avoid heating and pitting of the surfaces which first come into contact. There is, of course, from a fire-risk point of view a possibility of persons so inclined to tamper with this type of switch, and in addition, if the switch be of flimsy make the contact pieces may become so bent or roughened as to prevent the contact lever being pushed right home even by well disposed persons. A well-designed switch should have all pivots securely fastened by split pins or other means, obviating any possibility of their working loose, and speaking generally, it is bad practice to pass current from stationary to moving parts by means of pivots, whether in a switch arc lamp or other electrical apparatus, for pivots are always subject to jarring and wear, and arcing will almost inevitably occur, sooner or later destroying the pivots.

(2) With regard to the nature of the switch contact surface, it may be noticed that, although with the brush type of switch, shown in Fig. 8 *(illustrated in March issue)*, we have a good adjustment of the rubbing surfaces to one another, the area of contact cannot in any case exceed that of the combined section of the plates forming the brush or lever, and is after usage generally much less, owing to oxidation and pitting of the rubbing surfaces. On the other hand, the contact surface of the type of switch shown in Fig. 9 *(illustrated in March issue)* considerably exceeds the sectional area of the contact lever, and enables such type of switch to compare very favourably with more expensive types with brush contacts.

Some rules specify that all switches must be tested with current + e.m.f. 50 per cent. in excess of the working values of the circuits for which they are intended without undue heating of parts or arcing, and if a switch really complies with this test we have a certain factor of safety as regards its general conductivity and contact surface deterioration.

Adjustment for wear at contacts is usually slight, and is generally attained in modern switches by the simple expedient of employing "springy" metal in the contact lever or in the terminal pieces; but should a switch become hot from other defects, such as bad connections to terminals, insufficient metal or dirty contacts, this source of adjustment may prove very unreliable.

(3) The general conductivity of the switch as a whole is of great importance, and some rules go so far as to specify that the current density in any metal pieces forming the switch should not exceed 500 amp. per sq. in.; but troubles more frequently arise from defective terminals, which are often made altogether too slight and weak for the proper connection of the size of wire corresponding to the currents they are intended to be used with.

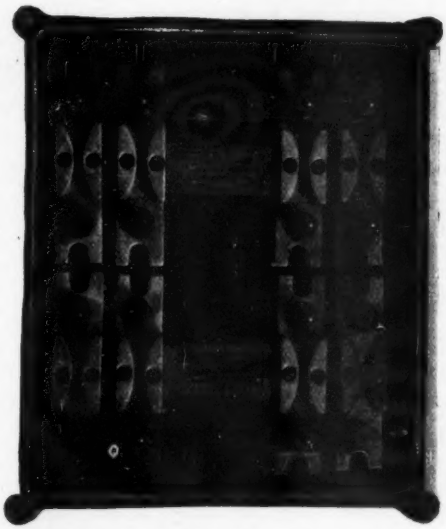


FIG. 14.—FUSE BOARD WITH PORCELAIN BASE.

Set-screw terminals, of sufficient substance to permit of a sound screw thread

and substantial set-screw, are preferable —on the grounds of easy wiring and permanence—to the use of cheese-headed screws, round which it is necessary to bend the strands composing the cable, and the writer is of opinion that with permanent installation work, sweated thimbles might with advantage be employed on smaller switches than is usual at present.

(4) The handles of all switches should be thoroughly insulated from any live metal parts forming the switch, not only to avoid unpleasant shocks at the instant of opening the circuit, due to its self-induction, but also to obviate danger from contact to earth by any means where live metal parts are exposed. In the case of arc lamp circuits and other circuits containing electro-magnets and possessing considerable self-induction, these shocks from switch-handles may become very serious, and particular care must be taken to avoid them.

With switches having exposed screw heads at the back which fasten live metal parts to the base there is considerable danger, and in the event of the wood blocks upon which such switches are mounted becoming damp they are readily carbonised by the contact of the live screws, and will in all probability fire eventually. Quite apart from this, the insulation of circuits having such switches upon them will be very poor.

To obviate this difficulty we find in some switches that the screws fastening the metal parts are threaded into the porcelain itself, which, however, is not a very reliable method, as such threads are seldom satisfactory. In other switches the screw heads are counter-sunk in the back of the base, and the hole is then filled with plaster of Paris or other unsuitable material. Those bases on which the metal parts are fixed by means of lugs fitted into depressions in the porcelain and held by pins passing through the side of the base, which are protected by the porcelain cover of the switch when in position, are to be preferred.

With the slate bases which are generally employed for main switches, special care should be taken to insulate them by means of porcelain bushes from woodwork and walls, if good insulation of the circuit is desired, as the slate itself is often a poor insulator.

Both porcelain and slate bases should be glazed or well varnished at the back, and in wiring all switches or other fittings particular care should be taken to remove the braid and tape for an inch or so from the end of the rubber on the cable. If this point be attended to, much improved insulation will result, as the braid and tape are usually somewhat hygroscopic and should not be allowed to come into contact with the live metal terminals of fittings.

(5) As soon as pressures of 200 volts and over became the usual thing, a general revision of electrical fittings was found necessary, and the transition to these so-called high voltage fittings is by no means yet complete.

Although many fittings of good design already in use with the lower pressures were equally suitable with the higher ones, a point which had to be considered was the extra length of break required in the switches and fuses under these higher pressures. This at first sight might appear an easy matter to determine by experiment, and probably some persons have satisfied themselves in this respect; the writer, however, must admit that he has encountered some difficulty in the matter, and results appear to depend on many variables in practice.

First, as already explained, when dealing with fuses, we find the amount of current passing and the resistance of the circuit have a lot to do with the length of arc obtained at a fuse or switch; secondly, we find the composition and size of the metal forming the electrodes or pieces across which the arc occurs affect the result; and, thirdly, although the conditions of experiment on one day are, as far as can be seen, identical with those upon another day, the lengths of arc obtained differ considerably, possibly due to some atmospheric condition or other cause. The only way in which to get any results at all reliable appears to be to make a great number of experiments on different days, which involves much time and patience. One point to notice with regard to the

length of arc obtained at a switch is that the working conditions differ from those in force with fuses in an important respect.

In the case of a fuse being blown, the effect may be, and generally is, due to a short circuit with little appreciable resistance beyond that of the conductors in circuit. With the normal case of the opening of a switch, however, we have still the resistance of the lamps or other current-consuming devices in circuit, which materially reduces the length and virulence of the arc, and thus tends to protect the switch contacts. Few rules make any definite statement as to the length of break required at fuses or switches beyond the fact that the switch or fuse must be capable of acting satisfactorily with 50 per cent. increase in current and pressure above the maximum values on the circuit for which the switch or fuse is intended.

Some time ago the writer made a number of tests with 5-amp. and 10-amp. switches, then on the market, allowing the switch to arc by opening it gradually and noticing the fall in the current and the distance between the contacts at the instant the arc was extinguished. The results of several experiments are given in the curves (Fig. 11—*illustrated in March issue*) which refer to 110-volt circuits.

The upper curve shows the relation obtained between the current passing before the switch was opened and the corresponding length of break at which the arc was extinguished. The lower curve gives the approximate value to which the first current fell, due to the resistance of the arc at the time of its extinction

(*To be concluded.*)

A Visit to the Gold Mining Districts of Brazil.

By H. KILBURN SCOTT.

MR. HERBERT KILBURN SCOTT is a native of Leeds, and received his early engineering training at the Yorkshire College and with Messrs. R. Kilburn & Sons. Wishing to take up mining work, he came up to London and joined Dr. Edward Riley, the well-known assayer and mining expert, by whom he was sent out as representative to the iron mines of Elba. Whilst there he had the honour of officially conducting the Geological Society of Italy round that interesting little island, and on returning to England he read a paper descriptive of the mines of Elba before the Iron and Steel Institute. In 1895 Mr. Scott went out to Brazil to become manager of the Wigg Manganese Mines and Engineering Works in the State of Minas Geraes, and at last year's London meeting of the Iron and Steel Institute he presented a paper on the subject of Brazilian Manganese Mining. The industry, so far as Minas Geraes is concerned, practically owes its present important position in the world's production to Mr. Scott's energy and ability in prospecting and developing the original mines.

Besides reporting on various Brazilian gold mines, Mr. Scott has examined properties in Montenegro and Dalmatia, and visited the mining centres of Chili, Peru, Ecuador, the Lake Superior Region, U.S.A., etc. He is now practising as a Consulting Mining Engineer in Rio de Janeiro.

SOME little time ago the writer started from Ouro Preto, the old Portuguese capital of Minas Geraes, for a 250 miles ride on horseback through the famous gold mining district of Brazil. The question of sleeping accommodation and food promised to be rather troublesome, but fortunately there are many English in this part of the world, and the writer met with marked hospitality.

The sketch map, Fig. 1, shows the direction of the journey; the mines, etc., being numbered in the order in which they were visited.

In Minas the tops of the mountains are in the majority of cases very much inclined and rounded, due to their decomposed state. Everywhere there are mica, talc, and iron schists, all in an advanced state of decomposition.

The iron schists, called in different places Iterberite or Jacutinga, are immense beds of ore which crop up and are distorted in every direction. They go to form the Canga, a bed of iron ore conglomerate about a yard thick, which covers the country for hundreds of miles, and which is especially interesting, because it is this hard crust which prevents the country from running together, as it were, by keeping the decomposed mica schists in place.

Where the conglomerate is not found, and the iron has been broken up very finely, it mixes with the schists to a depth of about a yard, and forms the well-known *Terra Verinelha*, a very good coffee-growing earth. It may be mentioned that Jacutinga is used as a sort of general term for the micaceous iron schist. Jacu is the name of a Brazilian species of pheasant, and the name Jácu-tinga (or tinged) was given to this formation on account of the fancied resemblance of many of the specimens of ore to the feathers of that bird.

Itacolumnite is a schistose quartzite, and takes its name from the mountain of Itacolumna, overlooking Ouro Preto.

Iterberite is the massive schistose iron ore free from quartz, and taking its name

from the Peak of Iterbera, shown to the left of the sketch map. The peak itself (shown in Fig. 2), which is some 150 mètres high, is a wonderful sight, consisting as it does of solid iron ore, averaging 68 per cent. of iron. There is a weathering-formed conglomerate for many miles round, and, owing to the ore having been broken up fine before being knit together by the hydration of same, it has made a splendid macadam. On one occasion, when the writer was travelling up country, he rode over a stretch of it for four hours.

Ouro Branco (see bottom of sketch map) is the highest mountain in the district, and all round the foot of it there are immense heaps of rubble "cascalho," the dump heaps of the old gold-washers. The colour of the gold, as distinguished from that of Ouro Preto, gave the name Ouro Branco. This mountain consists of undecomposed gneiss, which in this case has withstood the decomposing agencies owing to the superabundance of mineral which it contains.

No. 1. Passagem.—The first mine which the writer visited was that of the Ouro Preto Gold Mining Company, managed by Mr. Henry Gifford. It is the second largest mine in Brazil, and the ore gives an average of ½ oz. per ton. The chlorination process is employed, this being the first place where the process was successful in Brazil. Frue Vanners are used for concentrating.

No. 2. Morro St. Anna.—The Dom Pedro Mining Company was originally started to work a continuation of the above-mentioned Passagem lode. Being in difficulties, however, Mr. Treloar, the superintendent (one of the pioneers of English gold mining in Brazil), discovered the famous "Maquinè" mine, from which great quantities of native gold have been taken.

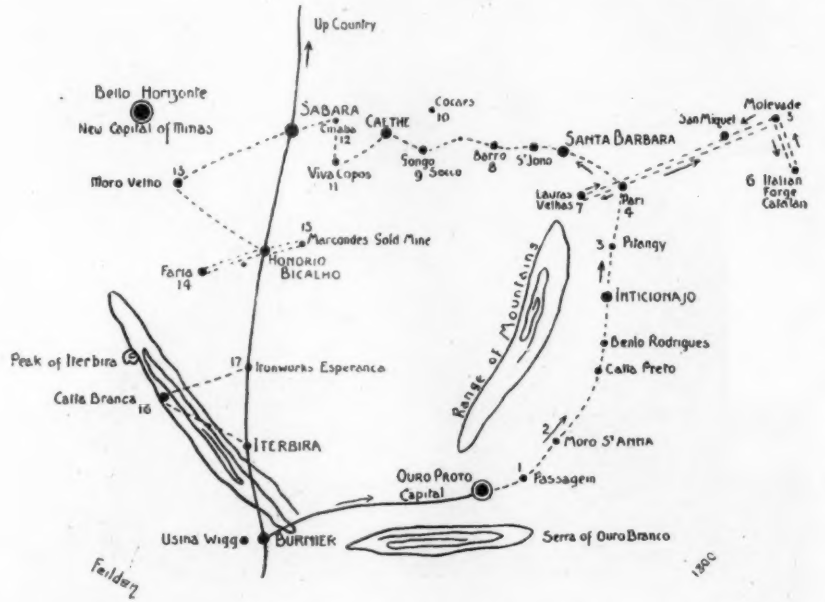


FIG. 1.—SKETCH MAP, SHOWING ORDER IN WHICH THE MINES WERE VISITED AND THEIR POSITION.

Fig. 3 shows the small Sandycroft 5-head stamps at Maquinè Mine, and west countrymen will recognise in the engineer on the right a typical Cornish miner. Fig. 4 shows the interior of the washing-house, the blankets for catching the free gold being in the foreground. At the back, on the left, a native woman is concentrating by hand in a wooden "batea." Figs. 5 and 6 give views of the mineral. Only the very best engineering and mining skill and the most efficient and up-to-date pumps, etc., will enable a Jacutinga mine to be worked successfully for a lengthened period. Half measures are worse than useless. Owing to its friability the pressure on timbering is enormous, and the writer has seen best quality hardwood timber, 2 ft. diameter, crushed like matchwood after being in

FIG. 2.—PEAK OF ITERRERA: ONE SOLID MASS OF PURE IRON ORE WITH SOME NATIVE IRON.

transmitting gear, as employed in this mine.

The Maquinè is what is known as a Jacutinga mine, and it had to be abandoned in 1895 because of water difficulties. Fresh capital was raised in London to reopen the original property of the company in the Passagem quartz lode, and new stamps and a chlorination plant have been laid down.

It may be mentioned that all Jacutinga mines are liable to be flooded sooner or later, owing to the porous nature of the position a comparatively short time. Along the road between Ouro Preto and Santa Barbara one passes through numerous villages, now almost deserted, which came into existence with the exploitation of Jacutinga mines by the English some 60 or 80 years ago.

No. 3. PITANGY.—This mine was opened up by a company which had not enough capital to make it a success. The ore is there right enough, but water has given great trouble.

No. 4. PARI.—The Santa Barbara Gold

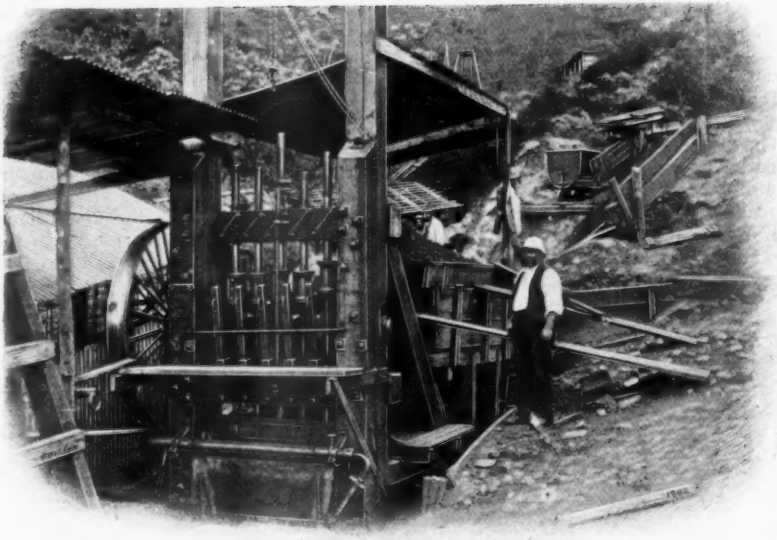


FIG. 3.—SANDYCROFT FIVE-HEAD STAMP BATTERY AT MAQUINÉ MINE.

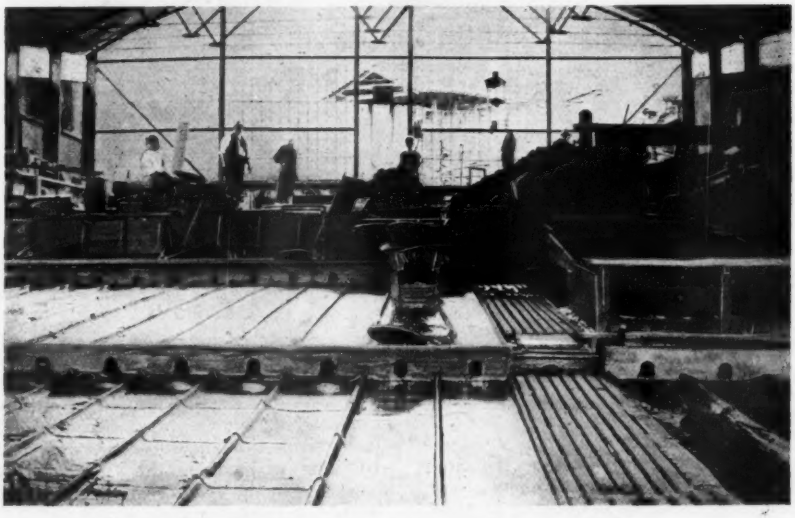


FIG. 4.—MORRO ST. ANNA GOLD MINE: WASH-HOUSE AND BLANKETS.

Mining Co. originally gave fair return, but as there are few modern appliances the gold is not being mined economically. The two waterwheels used for pumping and driving the mills are illustrated in Fig. 7.

The stamps shown in Fig. 8 are particularly interesting, because they were made by Brazilian labour. The wood is of qualities which would be highly prized in England, amongst others "Jacarand," a beautifully marked species of rosewood,

The mine is worked on the very bad system of "no filling in," that is to say, the mine simply consists of a large chamber with a hanging wall mainly kept up by props or "stulls." Although cheaper in first cost, the continuous examination and renewal of these supports is most expensive. The modern method of "filling in" with dead heads is infinitely superior, although more costly in the first instance.

No. 5. THE MOLEVADO IRONWORKS are fairly extensive, and were originally

FIG. 5.—MORRO ST. ANNA: FIRST TRESTLE OF ORE TRANSMITTING PLANT. THE MACHINERY IS UNDERGROUND.

being employed. As the schistose ore is easily broken up, these old-fashioned stamps serve their purpose fairly well.

In Fig. 9 the upper cylinders are the mercury amalgamation barrels, and the cisterns in the foreground on both sides are called "Saxe," their purpose being to effect the separation of the mercury amalgam from the earthy matter, the latter being run off over the blankets shown in the foreground, so as to catch as much of the remaining gold as possible.

erected at a cost of £40,000. They are situated in a beautiful position on the Rio Doce, and were started with the idea of making hoes, horse-shoes, etc., by American machinery, and with steel from Bloomery furnaces. The product of these furnaces was, however, very variable, often being a soft wrought iron instead of steel. In order to get over this, the iron was hardened by the cyanide of potassium and leather chippings process.

Sig. Molevado made a large fortune

FIG. 6.—TRANSMITTING PLANT OF THE MORRO ST. ANNA GOLD MINE.

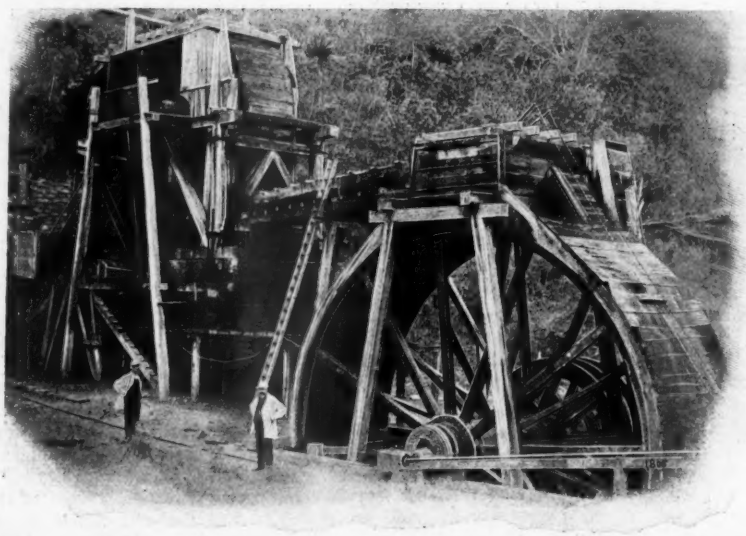


FIG. 7.—WATERWHEELS OUTSIDE ADIT AT PARI GOLD MINE.
THE TOP ONE IS USED FOR PUMPING AND THE BOTTOM ONE TO WORK THE MILLS.

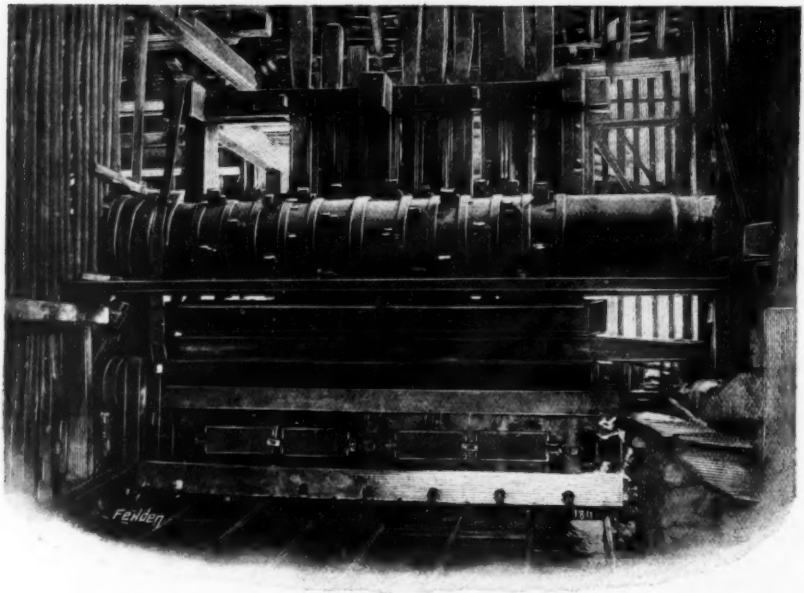


FIG. 8.—OLD BRAZILIAN GOLD STAMP (SHOD WITH IRON) AND TAPPET-SHAFT MADE FROM A TREE TRUNK.

in the slave days by making iron and steel on a modification of the Catalan process. He supplied the English companies in the golden days between 1820 and 1860. Although such an ancient process it is still worked, and the products are eagerly bought up because of the superior quality, due to the great purity of the ore. This splendid ore is lying about in great quantities. Figs. 10, 11 and 12 are views taken at these ironworks.

When visiting this district the writer stayed at the immense Molevado Fazenda, which, although built entirely of wood over 100 years ago, is still in a perfect state of preservation. The wood used, called "brauna," is a black species something like lignum-vitæ.

No. 6. BRAZILIAN FORGE.—The writer made a special journey of 30 miles to photograph this forge. The system is only slightly different to the ancient Catalan forge in the shape of the hearth.

There are two variations of the Catalan forge in use in Brazil, one being known as the Italian and the other as the Brazilian. In the former the ore is put into a series of steatite stone chambers a foot square and 3 ft. high, something like a small brass furnace; on the other hand the Brazilian furnace is quite open, like a smith's hearth.

No. 7. LAVRAS VELHAS.—This mine was until recently worked by Mr. Treloar, of Pari. It has now been acquired by the Saint Bento Gold Estates Co., who are the owners of Mine No. 8, which the writer also visited.

The ordinary gravity stamps have been substituted by dry crushers, and the ore is treated directly by the cyanide process; this method is giving good results, and the shares stand well in the market.

No. 9. CONGO SOCCO.—One of the most famous of the old mines in the Jacutinga formation. It yielded much gold in 1830, and the fact is placed on record that on February 7th, 1840, a

miner took out 30 kilos of gold in two hours. Like so many of the other mines, it was finally abandoned on account of water. People living in the vicinity, who ought to know, say there is any amount of gold still left, although the books of the original English company show that they tried hard to find fresh deposits before abandoning the mine. It may be mentioned that all mines worked in the Jacutinga formation gave very varying results, because the gold was mostly found in "pockets," and some of it was stolen by the workmen. This is always the case where the stuff shows free gold, whatever may be the precautions to make the men report finds immediately.

Congo Socco is a lovely spot, and it must have been a paradise in its prosperous days, as the company seems to have treated its employés very well. It is sad to see everything now in ruins.

A very interesting English miner lives at Carthe, near here. He has been in the district over seventy years, and tells many interesting stories of the prosperous times of the forties.

No. 10. Cocaes. — This is another abandoned mine. It was a very rich working about 1830, but never gave results to equal those of Congo Socco or Moro Velho.

No. 12. Guiaba.—This property belongs to the Moro Velho Co. It is only worked on a small scale at present, but the ore is fairly good, and the mine will probably be extensively worked in the near future.

No. 13. Moro Velho.—At Moro Velho, the largest gold mine in Brazil, there is quite an English colony, with a hospital, schools, etc. Mr. Chalmers is the genius of the place, which is a monument of what British energy, when properly directed, can do.

The unwatering of the old mine was a particularly fine piece of engineering work. It appears that about 1875 the mine was flooded, and operations had to

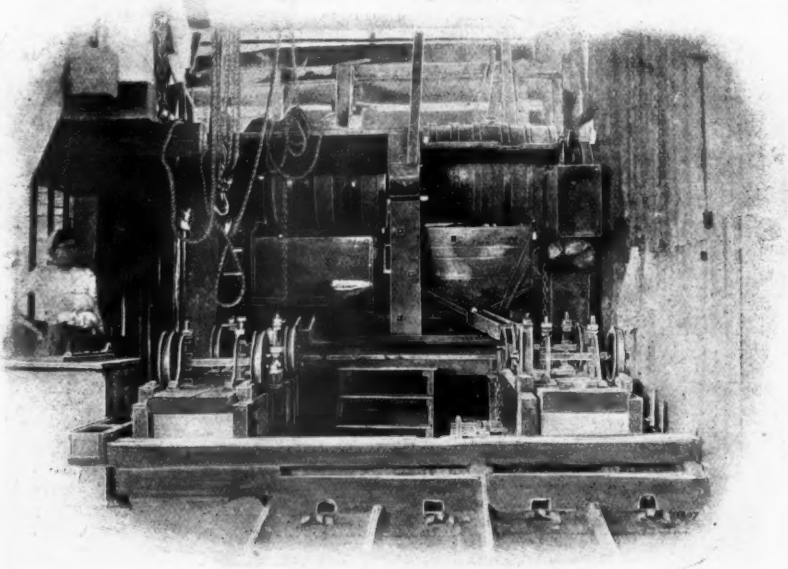


FIG. 9.—AMALGAMATION PLANT AT PARI MINES.

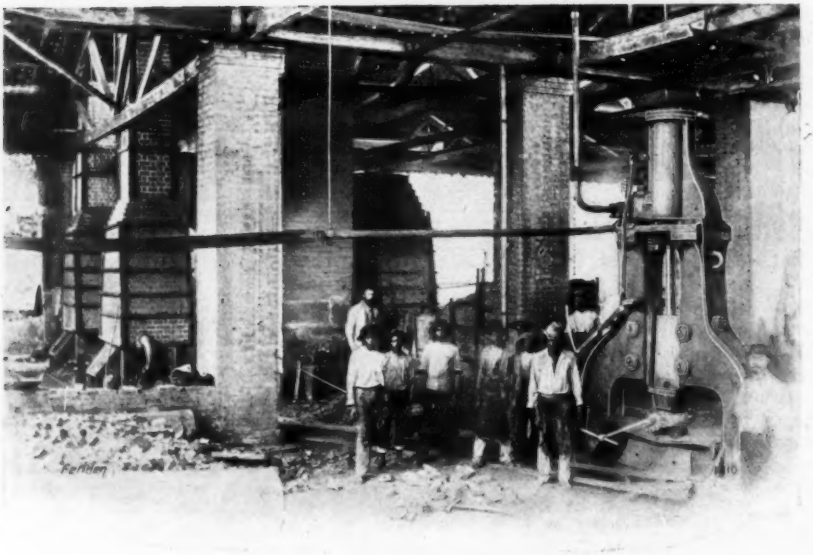


FIG. 10.—MOLEVADO IRONWORKS: AMERICAN FURNACES AND STEAM HAMMER DRIVEN BY WASTE HEAT FROM FURNACES.

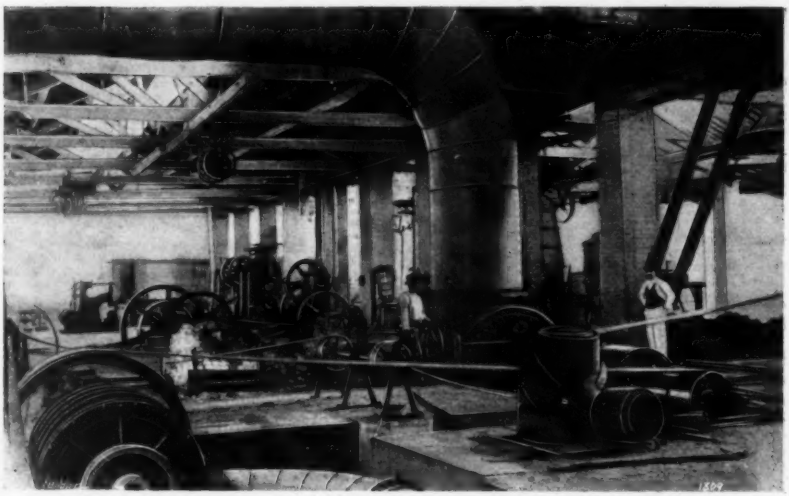


FIG. 11.—MOLEVADO IRONWORKS: MAN AT WHEEL OF 500 H.P. TURBINE. IN BACKGROUND, AMERICAN MACHINES FOR PRESSING HOES.

be suspended; a shaft was then sunk to a much lower level, about 1,000 yds., but in order to prevent any possibility of the water breaking through unexpectedly, and to get the whole of the intermediate ore body, it was decided to tap the old mine, which was full of water. Owing to errors in the old drawings, the borers were not at first able to locate the lowest position, but the water has now been pumped out by means of powerful Hathorne Davey pumps.

There are altogether 50 miles of water-courses for driving the machinery by water power, but as the supply is rather uncertain, stand-bye engine power is necessary.

The mine is worked on the filling-in system, that is, for every trolley of ore which comes up, one full of earth goes down. At one time the slimes were used for filling, but owing to the oxidation of the pyrites considerable heat was generated. Although a quartz mine it was found impossible to continue the old system of timbering on account of the expense.

Electric transmission of power was introduced some years ago, and is now to be extended on a large scale. A railway connection to the main line is also being made. Fig. 13 shows the ore leaving the adit on an endless chain, the winding engine for this purpose being illustrated in Fig. 15.

No. 14. FARIA.—This mine originally belonged to a French company, which came to grief. It changed hands some time ago, and has recently been floated with English capital. From enquiries which the writer made, there is every reason to suppose that the mine would give good results if properly worked.

No. 15. At HONORE BICALHO there is a gold mine worked by Brazilian capital and management. The ore being very pockety and the methods primitive, the manager has rather a struggle to make the mine pay.

No. 16. CATTA BRANCA.—Here money

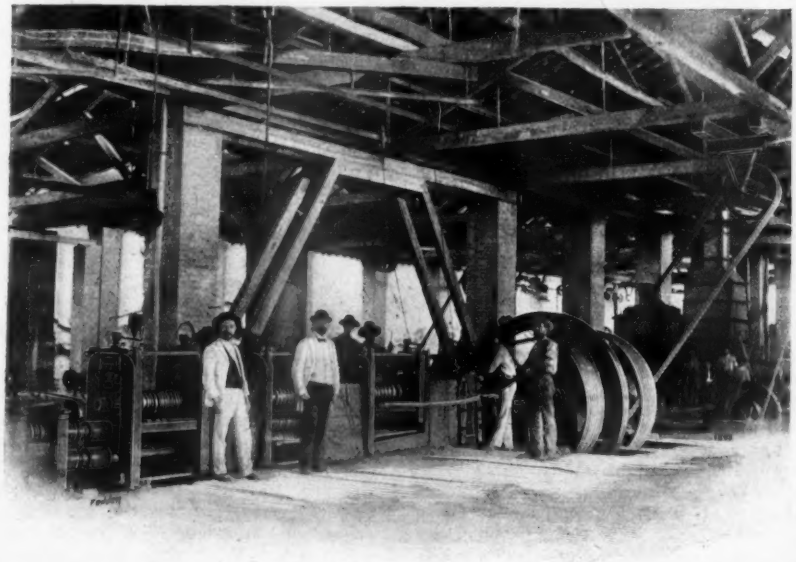


FIG. 12.—MOLEVADO IRONWORKS: ROLLS AND A RE-HEATING FURNACE.

has been squandered right and left above ground, but nowhere has the writer seen underground work so badly done. No wonder, therefore, that the foot wall slipped, burying along with it some 25 native miners.

The ore averages half an ounce per ton, and is in a quartz vein traversing the Italcolumnite rock. Fig. 14 gives a good idea of the appearance of a rocky mountain top near Catta Branca.

although Brazilian gold mining, with a few brilliant exceptions, has been under a cloud for some years, there are indications of a revival. As elsewhere, over-capitalisation has been responsible for many failures. Coffee-growing having failed, both the Federal Government and the Government of Minas Geraes are adopting a more reasonable attitude towards the mining industry by allowing in free all mining machinery and general stores, and by reducing the

FIG. 13.—MORO VELHO: ORE TRAMWAY ADIT ON ENDLESS CHAIN. AIR COMPRESSORS ARE IN LEFT-HAND CORNER. FOUNDRY AND ENGINEERING SHOPS ARE ALSO TO LEFT-HAND. IN THE BACKGROUND ARE STAMPS, ETC.

No. 17. THE IRONWORKS OF ESPERANCA were built to use the loose water-worn iron ore which is found immediately under the conglomerate, and which appears just as do the stones on a sea beach.

There is enough iron in Brazil to supply the world, but unfortunately there is no coal and very little charcoal with which to smelt it. Perhaps a succeeding generation will solve the problem by employing petroleum coke and electric smelting.

In conclusion, the writer would say that export tariff on gold from 5 per cent. to 3½ per cent. One can also now take up a property with much better prospect that his rights will be always respected. Lawsuits as to title have been in the past a great obstacle to the introduction of foreign capital. Above all things, successful Brazilian mining, in the Jacutinga formation especially, requires the most expert engineering knowledge and the very latest appliances. What has been done at Morro Velho by the St. John del Rey Gold Mining Co., could be repeated else-

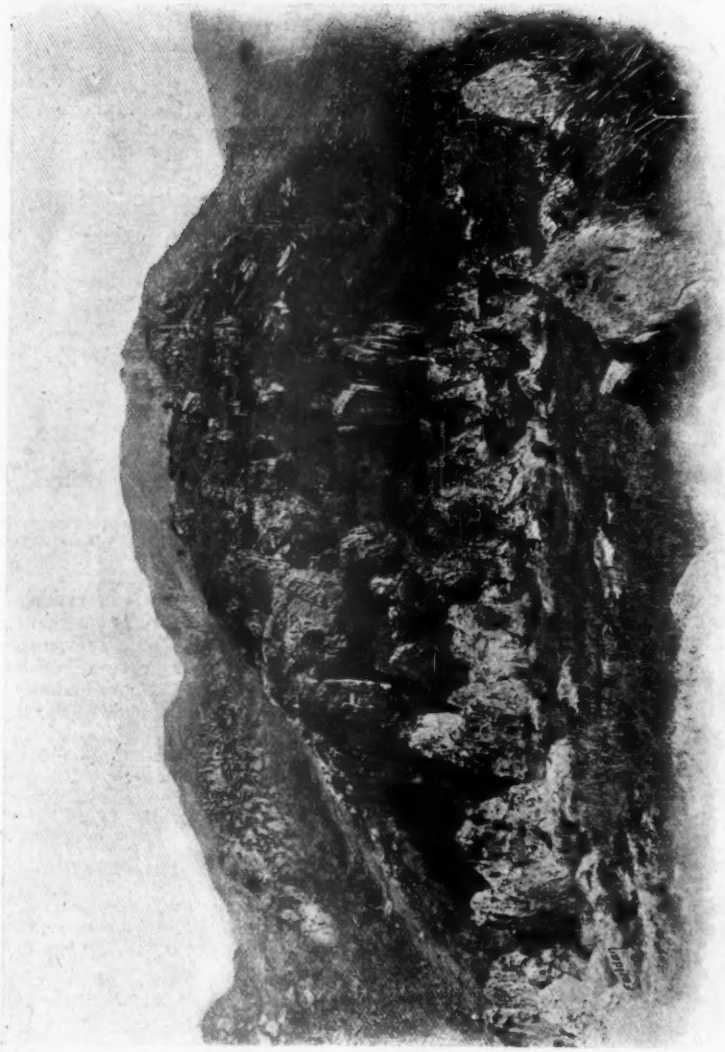


FIG. 14.—A VIEW OF ROCKY TOP OF MOUNTAIN NEAR CATTA BRANCA.
CATTA BRANCA WORKING IS A QUARTZ LODE CROSSING THE QUARTZ SCHIST.

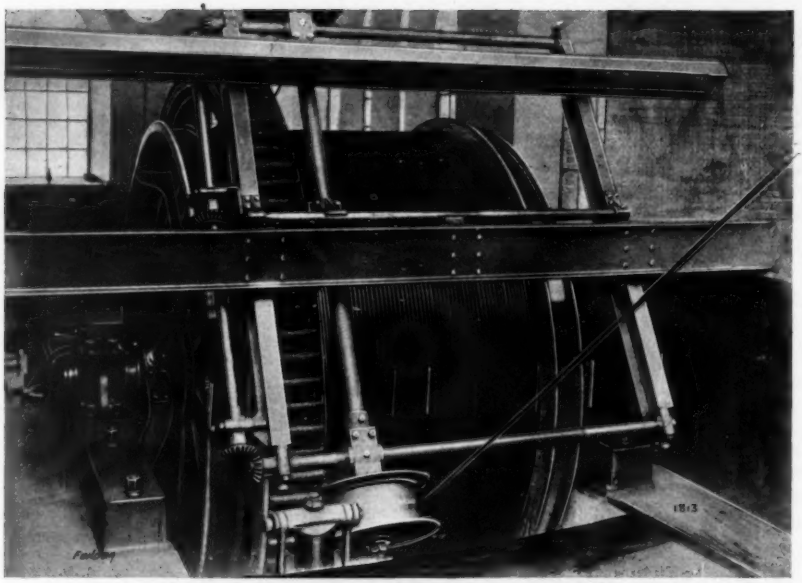
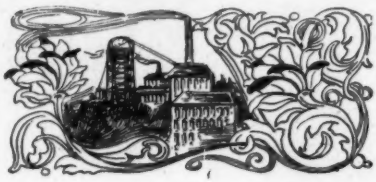


FIG. 15.—MORO VELHO: WINDING ENGINE.

where, given the right engineers and an enterprising and reasonably constituted directorate.

The difficulty with regard to power, which was such an expense in the old days, can now be solved by multiphase electric current transmission, making it possible to utilise the various water-powers which are available. Railway transport has been also much improved of late, partly owing to the large amount of manganese now being sent down the line.

H. KILBURN SCOTT



MACHINERY, APPLIANCES AND PROCESSES.

"Every part and side of our life, from the cradle to the grave, has been touched and tended by the inventor and manufacturer. His works are as numberless as the sands of the sea, but the onward rush of Science and the Arts opens up new fields of discovery and enterprise as each day dawns. Let us choose here and there among thousands, and in choosing take the best as far as in us lies."

AN IMPROVED ROVING FRAME.

AMONG the improved cotton machinery of the present day, a roving frame recently placed upon the market by Messrs. Asa Lees & Co., Ltd., and constructed at the Soho Iron Works of the firm at Oldham, deserves the attention of our cotton spinners, both for the design of the machine and for its accuracy in working. Whilst to explain every detail of the construction and working of this roving frame would take up more space than we have at disposal, we should like to draw the attention of our readers to a few of its special features. The differential motion employed embodies the principle of Rhodes and Curtis's motion, but has been considerably improved. Great care has been taken to sufficiently guard all the working parts of the frame which indicate the possibility of danger; the patent automatic self-locking doors enclose not only the differential motion, but also the twist and cone drum wheels, and are devised in such a way that the machine cannot be worked

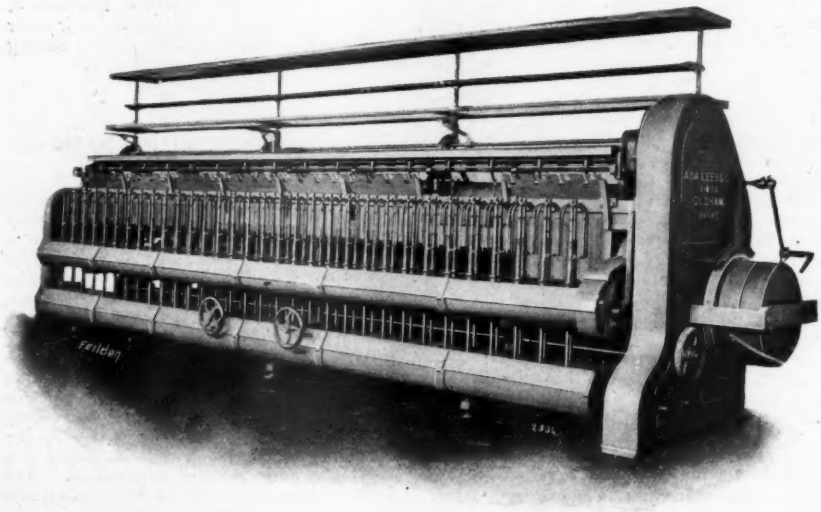


FIG. 1.—IMPROVED ROVING FRAME: FRONT ELEVATION.

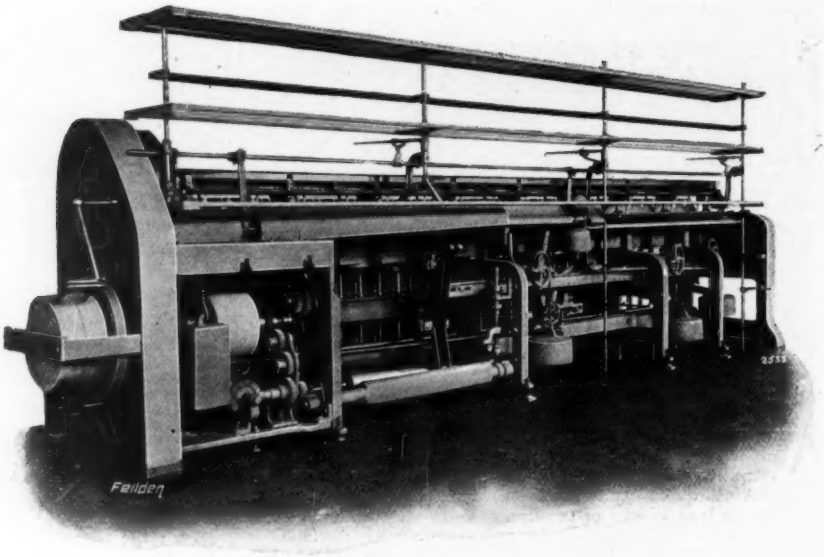


FIG. 2.—IMPROVED ROVING FRAME: REAR ELEVATION.

whilst the doors are open, and the latter cannot be opened whilst the machine is running. Another improvement is the adoption of Taylor's patented cone-releasing motion, connected with the knocking-off mechanism, which causes the bottom or driven cone to rise, thus stopping the winding, but allowing the spindles and rollers to revolve, so that sufficient roving can be delivered for doffing purposes. By an ingenious device the cone strap can be tightened without the operation interfering with the running of any portion of the machine, so that it is always possible to secure an equal degree of tension upon the strap. Another patented appliance permits the reversing bevels to be put out of gear, enabling the attendant to wind the bobbin-rail to the top or bottom of the lift as required. The various parts of the machine are well finished, the spur wheels throughout, and also the lifting racks, have their teeth cut out of the solid metal, so that the gearing works smoothly and with very little noise. It should be mentioned that although we particularise the roving frame, Asa Lees & Co's slubbing and intermediate frames are similar in design and construction, and all the improvements notified above are equally applicable to them. For the latest product of their mechanical skill Messrs. Asa Lees & Co. deserve great credit, and their flyer frames will occupy an important place among modern cotton-spinning machinery.

No. 12 UNIVERSAL MILLING MACHINE.

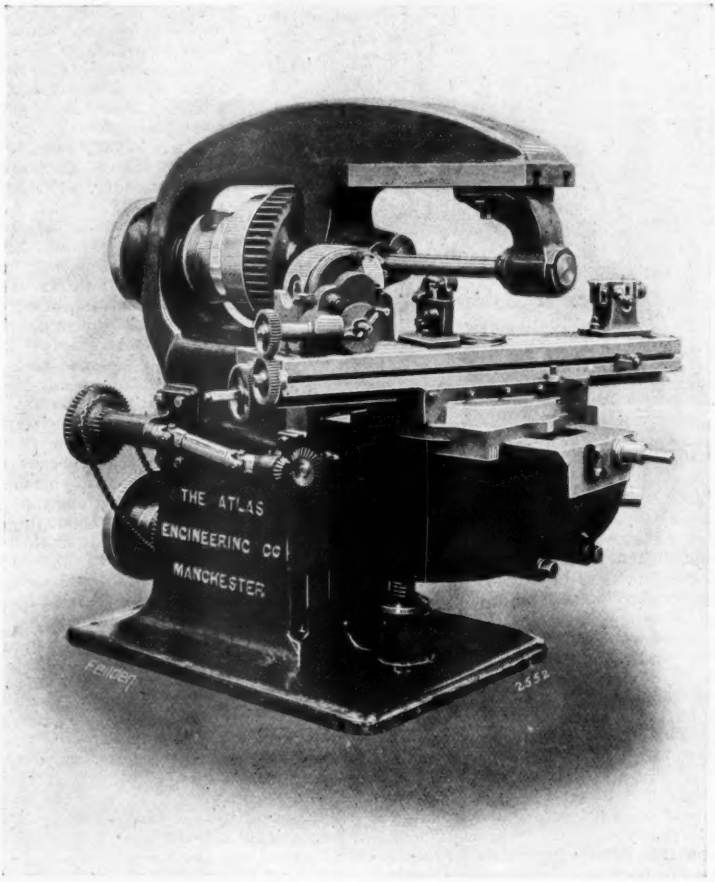
THE illustration represents a powerful and heavy horizontal milling machine, with some special features. The platen is 4 ft. long by 12" wide, and is indexed for swivelling to an angle of 45°. The feed is by means of a short, stiff, telescopic shaft, driving worm and wheel through bevel gears shewn. Six changes of speed are provided, three by chain wheels and Hans Renold's chain, and two by cone from spindle on to cone at base of machine. By the use of this chain, which is noiseless, positive, and highly satisfactory, the telescopic shaft can be brought close to machine side, giving it a very neat and compact appearance. The knee is strongly gibbed to body slides, and in addition has four 1" bolts sliding in slot-holes in front face. When these are tightened the whole of the moving parts are practically

solid with the body, forming the most rigid support for the heaviest weights and cuts. The table has a transverse movement of 9′ and vertical movement of 24″. Self-acting feed can be provided in all directions with improved automatic stops. A three-speed cone of large diameter with powerful ratio of gearing gives ample power for heavy work and large cutters. Oil pump, tank and connections complete the necessary outfit. It is only necessary to say The Atlas Tool Works, Levenshulme, Manchester, are the manufacturers as a guarantee of the workmanship.

APPLICATION OF THE HOLMES-CLATWORTHY PATENTED SYSTEM OF COUPLED MOTORS

FOR OBTAINING WIDE RANGE OF SPEED VARIATION TO LARGE ROTARY WEB NEWSPAPER PRINTING MACHINES.

MESSRS. J. H. HOLMES & COMPANY, of Newcastle, who have probably had more experience than any other firm in this country in electrically driving all the



UNIVERSAL MILLING MACHINE BY THE ATLAS ENGINEERING CO.

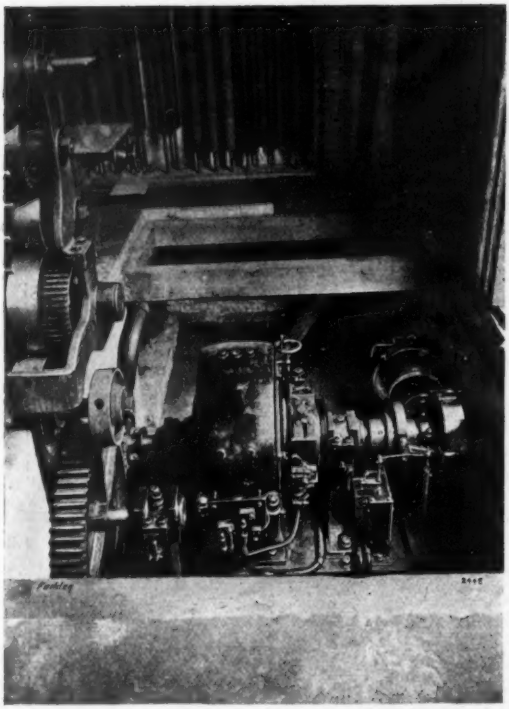


FIG. 1.—HOLMES-CLATWORTHY COUPLED MOTORS ARRANGED TO DRIVE PRINTING MACHINE.

various kinds of printing machines for all purposes, have devoted special attention to newspaper machine driving, and have tried nearly every method of driving by belting, gearing, friction clutches and direct coupling. Several years ago Messrs. J. H. Holmes & Co. designed a special form of friction clutch and slow gear which worked very well, but they have now abandoned all the above-mentioned methods of driving in favour of the Holmes-Clatworthy system, which has as high a factor of economy as is possible. This system is the invention of one of their own engineers, and is essentially an English invention, though something similar was "invented" several months later in America. In this system both the printing machine users and the central supply stations' requirements have been met in a most complete way. A shunt wound motor is directly coupled or geared to the machine-driving shaft of just sufficient power for driving the machine at full speed. There is no need of any series of turns on this motor, as it is never under any circumstances called upon to exert more than its ordinary rated output. It is only used for the actual printing speeds, and always works under most economical conditions. An auxiliary motor is used for all the operations of adjustment, and for leading in, and is fitted with a worm gear, moving the printing machine through the medium of the main motor shaft, to which it is connected by an electrically operated self-releasing claw clutch. The auxiliary motor is of just sufficient power for starting up the machine from rest, and for dealing with all the preliminary operations of "turning round," and "leading in." The auxiliary motor is series wound, and works under its most economical condition. Only one motor is at work at a time, excepting for a second or two when changing over. The very smallest movements of the printing cylinder are easily obtained, and can be regulated in speed from two revolutions to 200 revolutions per minute. The starting of the machine from rest is so slow and perfectly easy that it is difficult to tell the machine is in motion. An important feature of this system is that only about 10 per cent. of the full power is required to set the machine in motion.

It is also important to note that neither motor is running nor any current being used when the machine is standing.

The whole of the operation of starting, adjusting, leading in, and printing speeds are effected by a single handle or wheel. In the event of the paper breaking, or other accident, the machine can be immediately stopped by the mere pressure of a push button, several of which are conveniently located about the machine. It is impossible to start the machine without the use of the auxiliary motor. In the event of the current supply from any cause failing, the circuit is automatically broken, and the motors cannot be started without bringing the switch first to the "off" position. It is also impossible to start the machine or turn on the current too rapidly.

These latter points are appreciated by the central station authorities. The first installation of the kind was put in at the *Liverpool Courier* offices, and has been running daily for over two years. It is of peculiar interest from the fact of its complete flexibility. The printing machine is one of Mr. Wilson's 3-reel Victory type in three identical sections, A, B, and C, each capable of printing four pages. Two of the Holmes-Clatworthy sets have been applied here, so that A and C can be run at the same time, but quite independently, for two 4-page papers, or A and B can be run as an 8-page, while C is run as a 4-page. Again, B and C can be run as an 8-page, while A is running as a 4-page. Finally, A, B, and C, and the two motor sets, can be all coupled up mechanically and electrically for printing a 10 or 12-page paper. All these combinations are carried out at different times with great success and economy, facts which are proved by the receipt of duplicate orders for similar arrangements. It has been frequently stated by a very eminent firm of large press makers that two sets of motors and gear cannot be satisfactorily run coupled in parallel on the same machine, so that the above is of great interest to newspaper machine owners.

Messrs. J. H. Holmes & Co. have supplied quite a large number of these equipments varying in power from 60 to 20 h.p., one office alone having nine complete equipments.

The illustrations are from a photograph of an equipment at the *Hull Daily Mail*. The machine is one of the latest large "Hoe" quadruple type. This will print 48,000 4, 6 or 8-page papers per hour, and 24,000 10, 12 or 16-page papers per hour. There are two folders and two reels. The area of the paper is equal to the *East Yorkshire Times*.

The motor is of J. H. Holmes & Co.'s VI.-pole Castle type, 50 b.h.p., 500 revolutions per minute, being fitted with a gun-metal pinion gearing, with a cast-iron spur-wheel on the machine driving shaft. The machine takes over 200 ampères 200 volts to run at full speed, and at starting the current is only 19 ampères.

THE "FORGROVE" PATENT AUTOMATIC WRAPPING MACHINERY.

THE "Forgrove" patent wrapping machinery, which is the speciality of the Forgrove Machinery Company of Greek Street Chambers, Leeds, is made in all sizes to suit the goods to be wrapped. The machine, which we now illustrate, is specially designed to suit the requirements of confectionery manufacturers; and machines of this type have been supplied by the company to some eminent firms for chocolate and toffee wrapping in tinfoil.

This machine, which is of British origin, is of wide application not only to confectionery makers, but to an increasing number of manufacturers who stimulate the sale of their wares by wrapping them in attractive packets. In view of the far-reaching use of the invention it has been patented in important foreign countries.

The following is a brief description. Referring to Fig. 1, which is a side elevation of one of these machines suitable for wrapping chocolate, blacklead, small boxes, etc., we see the driving-pulley *P* on the shaft. A disc-crank working between the frames *A* actuates the rocking-lever *B* by means of a connecting-rod. A lay shaft *G* works with a two-to-one bevel gear from the main driving shaft, and carries two plain cams for operating the feed. Such are the primary movements of the machine. All further movements required for folding the wrapper round the

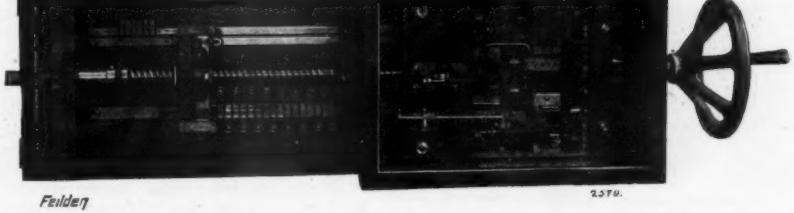


FIG. 2.—HOLMES-CLATWORTHY SYSTEM OF COUPLED MOTORS FOR DRIVING PRINTING PRESSES: THE CONTROLLER.

tablet are obtained by contacts of the mechanism carried on the head of the oscillating-lever *B* with the stationary frames.

The upper end of the link *B* terminates in a T-head carrying upon its arms two wrapping boxes. When one wrapping box is under the discharge hopper *C* the other is under the feeding hopper *H*. Thus one box takes in a tablet whilst the other is discharging its wrapped block, sufficient time for these operations being obtained by reason of the very slow movement of the rocking-arm when the crank which drives it passes its dead centre. As each wrapping box moves from the central feeding hopper to its delivery hopper the wrapping is performed, and at the same time the mechanism, which has already performed one wrapping operation, recovers itself ready for the next whilst travelling from the discharge hopper to the central feeding hopper. By this arrangement time is economised with the assistance of but few working parts. The machine illustrated works with ease at an output of 6,000 tablets per hour, and such is the perfection of the mechanism that it is almost silent in action.

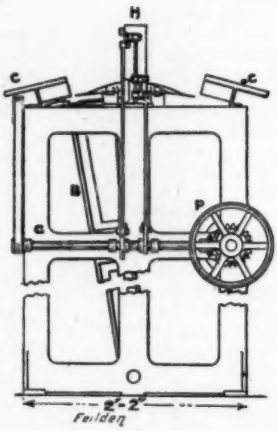


FIG. 1.—SIDE ELEVATION.

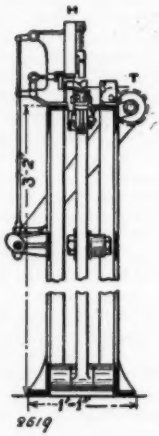


FIG. 2.—END ELEVATION.

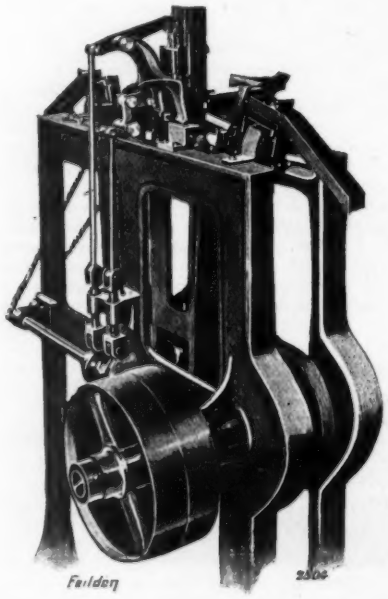


FIG. 3.—GENERAL VIEW OF THE "FORGROVE" PATENT AUTOMATIC WRAPPING MACHINE.

For feeding the tablets to the machine hopper, automatic travelling bands are supplied to manipulate them with the least possible amount of labour. For instance, when wrapping moulded tablets with beveled edges, it is found more convenient to pass them into the machine with the taper pointing downwards. This is, of course, the opposite way to which the tablets lie when knocked out from the moulds. By a simple attachment the machine is arranged to turn over each block before it is delivered to the feeding hopper.

All the parts are arranged so that the necessary cleaning may be done without their removal, but any part may be detached from the machine in a few moments, and can be replaced without skilled labour.

The machines are usually fitted with fast and loose pulleys, to be driven by a belt. When electric driving is required, the pulleys are removed and replaced by the "Forgrove" patent reducing gear, which enables the wrapping machine shaft to be driven at 50 revolutions per minute (the speed required when wrapping 100 tablets per minute) by an ordinary high-speed motor working at 1,600 to 2,000 revolutions per minute. This

reducing gear, which is a speciality of this firm, is also used to stop and start the machine instantaneously without stopping the motor; and a further advantage claimed is that it enables a purchaser to apply an ordinary motor without its own reducing worm and wheel or without cumbersome counter-shafting.

In addition to the machines illustrated, we understand that much larger machines are being constructed for wrapping soap and rectangular boxes, tablets, etc., of all descriptions.

The specialities of the company are the joint invention of Mr. Andrew Forbes and Mr. Frederick Grover, consulting engineers, of Leeds.

THE FIRST METAL RAILWAY BRIDGE EVER CONSTRUCTED. SITUATED AT WEST AUCKLAND, NEAR DARLINGTON.

THE FIRST METAL RAILWAY BRIDGE.

WE give an illustration of a cast-iron bridge which has been in position at West Auckland, about nine miles west of Darlington, since 1823—having been erected in that year probably by a Mr. R. Storey, for the first public railway (the Stockton and Darlington), to the designs of their engineer (George Stephenson). It is not known definitely who was the actual constructor of this the first metal railway bridge erected, but Mr. Storey is generally credited with the undertaking. The structure crosses the river Gaundless at what originally was the western extremity of the Stockton and Darlington Railway. It was at this bridge that on the opening day, 27th September, 1825, the Committee assembled and were drawn up in cars to Brusselton Tower, by a permanent engine, a distance of 1960 yards in 7½ minutes! To obviate this incline, however, the proprietors in 1839 undertook the construction of Sheldon Tunnel, which was opened in 1842. Consequent upon the opening of a new coal pit in the immediate neighbourhood, this old structure is now being replaced by a new bridge of greater strength to carry the heavy mineral engines now in vogue upon the North-Eastern Railway.

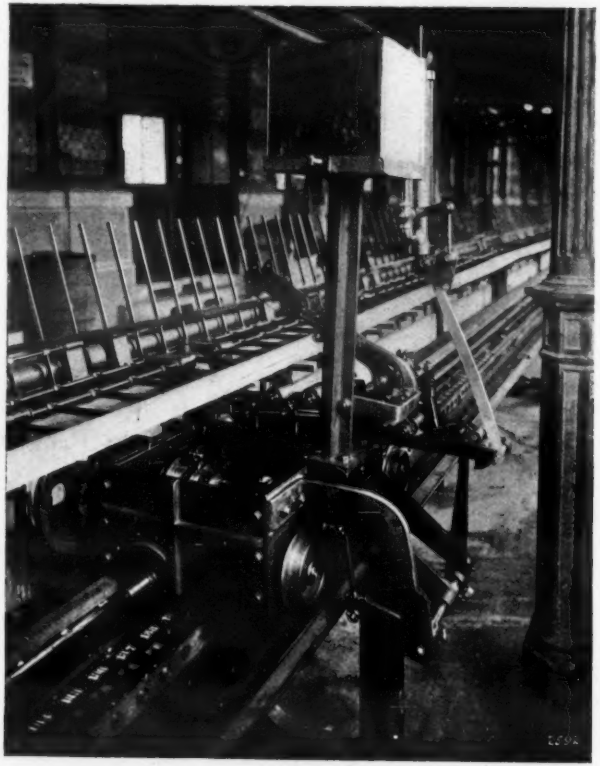
It has been suggested that this old specimen of earliest engineering shall be placed on a pedestal, at Darlington, alongside Stephenson's other relics, "the No. 1 Engine" and "the Derwent."

A REVOLUTION IN THE WEAVING AND DYEING INDUSTRY.

IT is our privilege in the following pages to give to our readers a description of an invention in the weaving and dyeing industry which promises to result in a total alteration of methods, and secure for the owners of the patents practically a monopoly in the manufacture of carpets and rugs of the Oriental type, and of similar tufted and pile fabrics, while the public at large will profit by obtaining these goods at prices which will be much lower than those prevailing at present, and enable persons even of moderate means to beautify their homes with articles, so far, within the reach only of the wealthy. The credit for these inventions belongs to Mr. Otto Hallensleben, a German engineer, who has for more than a year been demonstrating the efficiency of his methods by making use of them on a commercial scale in a factory established at Lucerne, to which the writer of these pages recently paid a visit, which convinced him that all that had been told to him of Mr. Hallensleben's process was not exaggerated. The improvements in the carpet industry, of which Mr. Hallensleben is the author, comprise two distinct processes, the one consisting of striking innovations in the method of dyeing or printing the yarn used in the manufacture of plush or pile goods for carpets, upholstery, and similar articles, and the other referring to an extraordinary increase in the efficiency of the loom used for weaving these goods.

In order to fully appreciate the real importance and the full bearing of Mr. Hallensleben's inventions, it will be necessary to throw a glance at the methods in use up to the present, and we will begin with the dyeing process as being—if there is to be a choice between inventions almost equal in ingenuity and importance—perhaps the most far-reaching of the inventor's discoveries. All existing methods for dyeing the yarn used in the manufacture of pile fabrics are based upon a process patented by Richard Whytock and George Lenk in 1839, the patents being purchased afterwards by Messrs. John Crossley & Sons, the well-known carpet manufacturers of Halifax, in Yorkshire. This process was later modified and improved by Mr. Joseph Crossley, George Collier, and James Hudson, whose patents have the date of September 28th, 1850, and its essential features are the following:—By a specially designed mechanism, the colour is placed upon the yarns after they have been wound in position side by side upon drums, varying in diameter from 4 ft. 6 in. to 15 ft., and more, and in width from 3 to 6 ft. Before the yarns, however, are placed upon the drum, the latter are covered with a drum or print cloth, as it is called, specially impregnated so as to resist the action of the colouring mixtures. The drums are provided with a collapsible section, and on their periphery an index is marked off in spaces equal to the width of the surface of the pile or loops required in the finished fabric. One end of the frame in which the drums are mounted can be lowered or taken away from the central shaft upon which it is constructed. Beneath the drums is a tramway, on which a truck, or carriage, is running, which contains a vessel holding one of the colouring mixtures required for printing or colouring a section of the yarn according to the design of the pattern which it is intended to reproduce. The truck or carriage, moreover, is furnished with axle-boxes carrying a small shaft, upon which is constructed a colour pulley, about 9 ins. in diameter and $\frac{3}{8}$ in. in width, revolving in the colour mixture. When the colouring or printing of the yarns is to begin, an assistant in charge of the truck containing the colour receptacle places the special colour required into the latter and speeds the truck on its way to the drums, and when the truck passes under the drum the pulley revolving in the colouring mixture impinges against the yarn and colours the portion of the surface marked off by the index. This process is repeated, the truck passing backward and forward, and the drum turning so as to expose the portion to be printed in each case, while the colouring receptacles containing the various colours are substituted one for another in agreement with the design, until the whole surface of the yarn wound on the drum has been treated and shows, side by side, a series of stripes varying in width and colour. In order to make the colours adhere in this process, it is necessary to add to them some sticky substance, generally ordinary starch, British gum, or some similar matter; while in order to make the colour penetrate the yarn and to remove excess, the manual labour of two assistants is required, who operate what are termed "scrapers" to obtain this aim. The excess of colour which is thus removed is entirely wasted, so that the method is not economical. The next step is to fix the colouring matter permanently, and at this stage the arrangements above mentioned—*i.e.*, the device for detaching one end of the frame supporting the drum and the provision of a collapsible section—come into play. By

1.
VIEW OF A COLOURING TRUCK, SHOWING THE JAWS IN ACTION APPLYING THE COLOUR.



2.
ANOTHER VIEW OF THE SAME TRUCK, SHOWING THE UPPER JAW RAISED.

FRONT VIEW OF THE COLOURING APPARATUS.
VISIBLE ON THE YARN ARE THE BANDS OF COLOUR THAT HAVE JUST BEEN APPLIED.

letting down the collapsible section the drum is thrown out of circle, and the assistants are enabled to place wooden rods beneath the prepared cloth on which the coloured yarn is wound, remove the cloth, and then place the yarn on a tray, on which it is conveyed to a so-called "steamer," where it is subjected to the degree of heat required for "setting" the colours. This steamer is a cylindrical steam-tight chamber, having a cross-section of an elliptical or any other form permitting the condensed steam being conveyed down the sides of the chamber, and prevents drippings from the centre, which would injure the colours of the yarn during the process of fixing or setting them. Finally, the yarn is withdrawn from the steamer, and after having been washed and dried, is ready for the loom.

The process above described, which is used in all branches of the weaving industry in which parti-coloured yarns are used for the manufacture of pile and tufted fabrics, although being a great advance upon the older, more primitive, and more laborious methods, still requires a very great amount of manual labour and a considerable number of operators, and has many drawbacks, among which are waste of colouring matter, the liability of the colours to run into each other, or to be unequally distributed, which leads to a confusion in reproducing the design, and the large amount of space required for carrying out some of the operations, etc. As regards the number of operators, it may be stated that for each pair of drums one workman, called a printer, and one assistant charged with changing the colours in the vessels in conformity with the pattern, are needed; two other operators are required for placing the yarn upon the drums and for scraping and rubbing the colours into the yarns, while a third set of men is wanted for preparing the printed yarn and conveying it to the steamer, in all about twenty-four assistants. The many manipulations performed by these men, and, above all, that of removing the prepared cloth from the printed, or coloured yarn, no matter how carefully accomplished, are the causes of an almost unavoidable running into each other of the colours of the still moist yarn. The mixing the colours with the sticky substances above referred to greatly varying in composition frequently sets up chemical action changing the shade of the colour, is apt to render the fabric dull in appearance and very unlike the brilliant oriental tapestry. The unequal distribution of colour occasionally taking place is due in most cases to atmospheric changes such as alterations

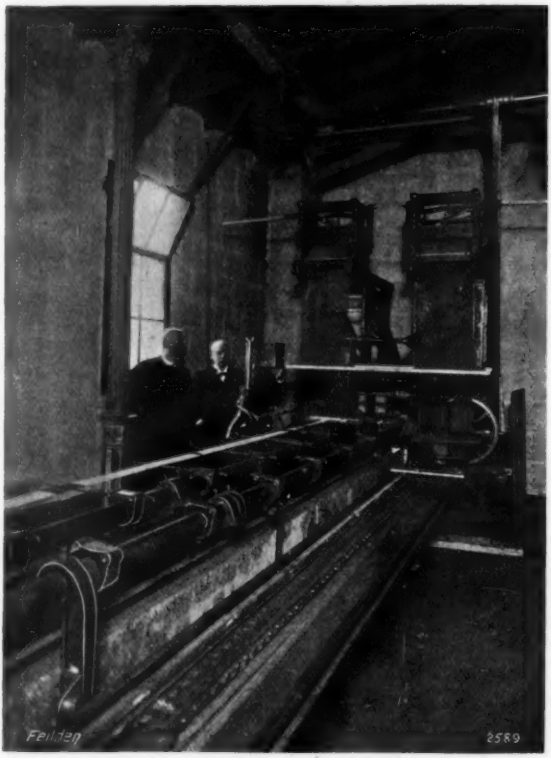
in temperature expanding or contracting the surface area of the drums, which are constructed of wooden lags resting upon iron frames. The preparation of the printing cloth for renewed use necessary every time that a layer of yarn wound upon it has been completely coloured, and consisting in its being thoroughly washed and dried, is both laborious and expensive, since these manipulations require considerable space, the size of the cloths varying from 13 ft. in length, and 6 ft. 6 ins. in width to 42 ft. in length and 6 ft. in width. Finally much time is wasted owing to the discontinuity of the various operations and the required intervals in the work.

All these drawbacks have been completely removed by the ingenious apparatus invented and designed by Mr. Otto Hallensleben who has succeeded in rendering the whole series of operations above described continuous and completely automatic, and in increasing the efficiency of the process more than tenfold. Thus, for instance, his automatic winder, requiring one attendant only, performs an amount of work equal to that done by six pairs of operators required by the process at present in use. The transfer of the yarn after being wound to the colour machine is the work of a moment, and the apparatus, moreover, is so arranged that the yarn wound to the length for the pattern to be printed is firmly held in a horizontal position and drawn taut without being subjected to undue tension. In general construction and action this apparatus resembles a slide lathe with its compound sliding rest; the printing or colouring trucks, operated automatically, traverse the whole length of the printing bed backward and forward without stopping, unless checked to permit the printing of the various sections of the yarn staked off in conformity with the pattern which it is intended to reproduce in the fabric.

For the checking of the trucks serves a Jacquard, the needles of which are put into action by a card coming in contact with them whenever the distance allotted for their journey is completed, and stopping them after they have travelled the width of one loop, two loops, etc., as required by the design. Thus, for instance, if the design requires that a certain colour shall be impinged on section No. 2 of the white yarn, or section No. 20 for printing the second loop, and on section No. 40 for the third loop, the card will be stamped accordingly, and the truck carrying the colour will be checked at the places indicated to enable the printing to be done, by means of an automatic device placing a pair of jaws in contact with the portion of the yarn that is to

VIEW SHOWING THE END OF THE COLOURING APPARATUS AND THE ENTRANCE TO THE STEAM TUBE, INTO WHICH LATTER THE YARN IS PASSED TO BE FIXED AND STEAMED.

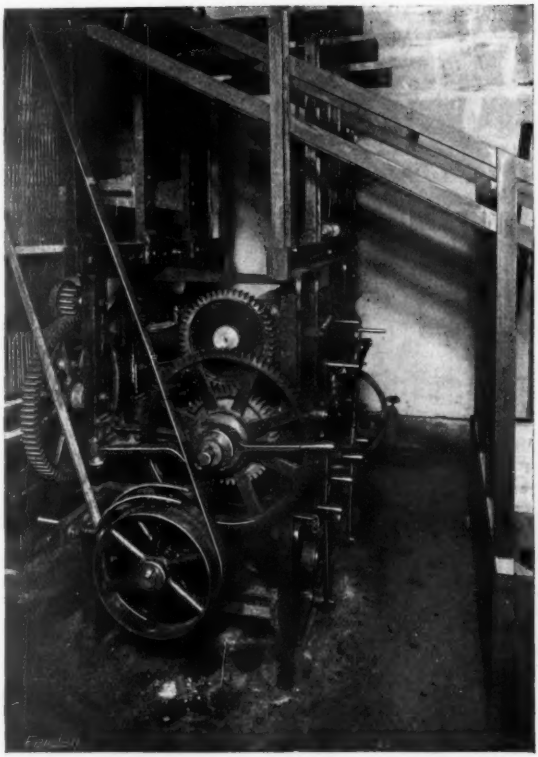
receive the special colour, and the operation is performed by one or more small colour pulleys, the number varying according to the class of yarn used for the fabric in course of manufacture, while by an ingenious combination of mechanical devices, the exact amount of colour required is previously measured off so as to prevent all waste. On the other hand, the amount measured off and held between the top and bottom pulleys is utilised to the fullest extent, and not impinging on the surface of the yarn merely, as is frequently the case in the ordinary process, is thoroughly rubbed into the yarn by these pulleys which are actuated by the jaws obtaining a reciprocating motion by the mechanism alluded to. Section No. 2, having been treated in this way, the truck recommences its journey until section No. 20 is reached, when it is stopped in order that the process above described may be repeated, and so on until the whole yarn is coloured and ready for the operation of setting the colours. Any number of colours may be applied simultaneously by employing a corresponding number of printing trucks. Without interruption the process continues by the coming into action of a device automatically transferring the multi-coloured yarn on a truck conveying it to a steam tube of only about 9 ins. in diameter, having its opening, through which the truck passes, directly opposite the colouring machine, and the moment the truck is admitted the door of the tube closes, the steam enters the tube, and the setting operation takes place, being completed in about a quarter of the time required by the customary process. This saving of time, and an equally great saving in fuel, which, of course, means an equivalent saving of cost, is due to the wise selection by the inventor of a tube of small dimensions, in place of the ordinary "cottage" chest, to fill which a minimum quantity of steam suffices, while at the same time the risk of condensation of the steam is completely removed. A further saving is obtained by the fact that Mr. Hallensleben's colouring and printing apparatus is duplicated, which enables him to use one of them for placing and preparing a second quantity of yarns for printing at the same time that the first quantity is being printed and steamed, and to continue the printing and steaming of one quantity and the winding and preparing of another simultaneously and without interruption, the two sections of the apparatus being alternately used for the one or the other set of operations. The washing of the yarn is also automatically performed by a special mechanism serving to remove the yarn after the colours have been set from the steam tube, aud to place it in a trough running down



THE JACQUARD END OF THE COLOURING APPARATUS.

the centre of the apparatus, where it is thoroughly cleansed. Finally the drying of the coloured yarn is performed in the customary way.

To sum up, the advantages of Mr. Hallensleben's important innovation, as far as the colouring process of the yarn is concerned, are the following. By rendering all the operations necessary for the purpose automatic, their accuracy and efficiency is enormously increased; and since two assistants with the new process are able to perform the same amount of work that in the ordinary process is performed by six pairs of drums, requiring the attendance of twenty-four operators, engaged in fitting the colour-boxes, printing the various sections, changing the colours, scraping off surplus colour, rubbing in the pigment into the yarn, carrying the latter to the steamer, washing the printing cloths and carrying them to the dry house, etc., the saving in cost of labour is so great that the universal adoption of the new process is a foregone conclusion, since to compete with it by continuing the old methods is hopeless. Add to these the excellent results obtained by means of Mr. Hallensleben's apparatus, the clearness of the colours and the mathematical accuracy in the reproduction of the design, rendering the effect equal in every way to that produced by the ordinary Jacquard and cards used in the manufacture of Brussels carpets, together with the low price at which the colouring of these Persian, Smyrna, or Turkish carpets and rugs, or similar pile fabrics, can be produced, owing to the rapidity of the process and the reduction of cost for wages to a minimum, and it will be granted that the inventor has accomplished a revolution in the art of dyeing, the full bearing of which, upon the development of this industry, in the future, it is quite impossible to anticipate at the present moment, but which is certain, not only to enrich the owners of his patents, but to place the luxury of bright pile-fabrics of perfect design and execution within the reach of thousands, to whom the present price is practically prohibitive.



DRIVING GEAR OF THE COLOURING APPARATUS.

We have, however, so far, but touched upon one portion of Mr. Hallensleben's inventions. Another, comprising his remarkable improvements in the loom, used for weaving these beautiful fabrics of oriental design, remains to be described, and, as will be seen, is hardly less important, both as regards his achievements and the possible consequences of the invention for the future of the industry which it concerns.

The loom designed by Mr. Otto Hallensleben, and which forms the subject of the supplement plate of this issue, is of the type known as "double fabric loom," by which two connected pieces of pile-fabric are woven simultaneously and by one operation, being separated as the weaving

GENERAL VIEW OF THE COLOURING AND STEAMING APPARATUS.

proceeds by severing them in the centre. An examination of the loom which has been in operation at Lucerne for nearly a year shows it to be what an expert who recently saw it correctly calls "a magnificent specimen of mechanical ingenuity." Its weight is over 10 tons, and it occupies a space of about 35 ft. in width by 10 ft. in depth; its height being 8 ft. The work that is being done on it at present is the weaving of a Turkish fabric of 10 ft. in width; but, of course, looms of greater dimensions and of the same construction can be built and adapted for the manufacture of fabrics 30 ft. in width or more. The essential characteristics of Mr. Hallensleben's loom are the following: A combination of mechanical devices by which it is possible to let off the warps, and take up the fabric without interrupting the process of weaving; another complex device which serves for operating the lay of the loom, and by which a sufficient amount of "dwell" or rest is given to it to permit the insertion of the guide-wire or bar, and the passage of the weft, or filling, into the shed of the fabric. The inserting and withdrawing of this bar is performed by a special mechanism, while another ingenious device serves for operating a series of knives or cutters for severing the two fabrics woven together, as above stated, and thus completing automatically their manufacture.

Last, but not least, the loom is so constructed that a special arrangement serves for placing continuously the weft, or filling, into its shed, which renders the use of a shuttle superfluous.

When it is borne in mind that in looms of an existing type the changing of the shuttle and its refilling, requiring in each case the stoppage of the loom, occupies even in well-organised factories about one third of the actual working day, the importance of this innovation will be appreciated. There are, however, other drawbacks connected with the fly-shuttle now in use, most notable among them being the fact that in order to propel the shuttle (which is confined in a box containing spring pressure to check and prevent its recoil) from box to box through the shed, a sudden powerful blow has to be brought into operation through cambs or their equivalents, and given to the picker, an operation consuming nearly half of the power required for working the loom. The abolition of the shuttle therefore not only prevents loss of time but also loss of energy, and is a feature of far-reaching consideration. Besides the saving of time and energy effected in Mr. Hallensleben's loom, must further be mentioned the smoothness and accuracy of the working and its adaptability to various kinds of wefts. It is, as testified by experts

of high reputation, equally suitable for manipulating the finest counts of weft or filling as well as the coarsest. Among the tests made was one in which weft spun from cow-hair was used, and which not in the slightest degree affected the weaving ; while, if this kind of weft were to be carried through the shed 10 ft. wide in the ordinary fly-shuttle, breakage would be almost certain to occur.

The above-described features of the loom, taken into consideration with the wonderful advance made in the dyeing process over the existing system, make it safe to predict that not only will Mr. Hallensleben's inventions secure him both wealth and honour, but practically give him the monopoly in that branch of the weaving industry to which they refer, since patent rights for his apparatus and working process have been acquired for all countries.

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WORKSHOP PRACTICE

The purport of this section of FEILDEN'S MAGAZINE is to give the skilled mechanic in our great industrial establishments an opportunity of bringing his practical ideas and experience into print. Inventive capacity and careful thought on the part of the workman is what we desire to encourage and foster. To this end we invite skilled mechanics, foremen, under-foremen, and heads of departments, to communicate practical suggestions, which, if accepted, will be suitably paid for. Wherever possible, drawings should accompany the contribution; rough sketches will suffice, as, when draughtsmanship is at fault, we will do all that is necessary to render them fit for publication. Nothing will be too poor for a careful inspection. Questions relating to shop practice are also invited, for which we pay one shilling. Answers to these questions that are printed are also suitably paid for according to merit.

❀ ❀ ❀

An Improved Pipe Vice.—The pipe vice shown at Fig. 1 is the ordinary type in general use, made with an opening in front, and V-shaped bottom on which the pipe rests, and is held by the pressure of the screw carrying the angle slide *S*. A greatly improved form, Fig. 2, consists of a frame *F*, made in cast or malleable iron, and carrying on a pin at *A*, the movable jaw *J*.

The body, having a base, can be bolted in any convenient position, and the jaw being free to swivel on the pin, can be brought into position at once. The top of the jaw is provided with teeth set in an oblique direction—practically a worm wheel segment of given pitch. The lever *L*, fixed on the top of the frame, has a cam or portion of a thread on its boss, which engages with the teeth on the jaw, and by a single movement locks it, thus gripping the pipe in the angles, which are furnished with serrated steel plates dovetailed into both frame and jaw.

The rapidity of both grip and release is the chief merit, while the advantage over Fig. 1 will be apparent to all who are engaged in pipe fitting, and who want a handy tool covering a wide range of diameters.

C. A. BURTON.

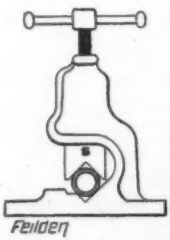


FIG. 1.

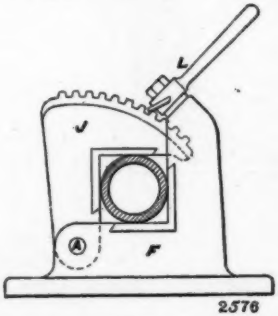


FIG. 2.

AN IMPROVED PIPE VICE.

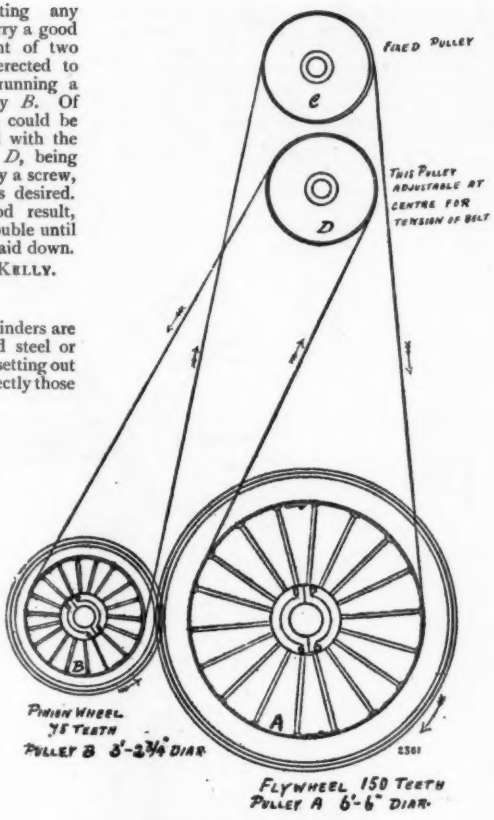
A Belt Arrangement.—Some little time ago, when passing through the shops of a Yorkshire firm of machine toolmakers, the writer noticed a rather ingenious arrangement of belts for overcoming a driving difficulty. Owing to the ever-increasing load on the shop engine with constantly laying down additional tools, the pinion wheel, *B* on sketch, gave a lot of trouble, losing several teeth at various times, necessitating annoying stoppages while a new tooth was fitted. A new steel wheel was ordered, and, before running this, the method shown on sketch was adopted to assist the pinion in driving the extra horse-power. On flywheel shaft end, a wrought-iron pulley, *A*, was fixed, 6 ft. 6 ins. diameter; in line with this another pulley, *B*, was attached to pinion shaft, but made $\frac{1}{4}$ in. less in diameter than the necessary diameter to give a speed similar to the toothed gearing. This difference in diameter kept the wheel

teeth in constant contact, preventing any backlash. The pulleys also would carry a good share of the power. The arrangement of two guide pulleys, *C* and *D* shown, were erected to overcome the obvious difficulty of running a crossed belt from pulley *A* to pulley *B*. Of course, several other positions of these could be devised. No difficulty was experienced with the belt slipping, the lower guide, pulley *D*, being fixed on an adjustable bracket worked by a screw, this allowed of tightening the belt as desired. The above arrangement gave a good result, working for several months without trouble until a new engine of increased capacity was laid down.

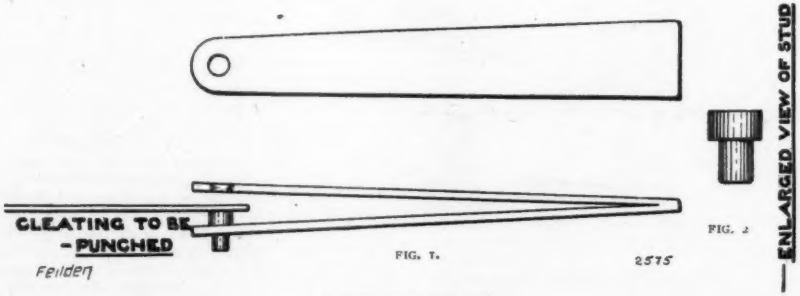
JAMES R. KELLY.

A Handy Cylinder Tool.—When cylinders are being cleated or covered with planished steel or sheet brass, a lot of time is spent in the setting out of the holes, so that they will meet correctly those in the cylinder flange. To punch these so that no unsightly marks shall be made, and to locate them in their exact position, a tool as shown at Fig. 1 is found most helpful. It is made of a piece of flat steel about ⅛ in. thick, bent over at one end, leaving the other open about a ¼ in. A stud or turned pin, Fig. 2, is inserted in the lower half, and a hole corresponding to the size of the stud—which is slightly larger than the diameter of the screws to be used—is made in the upper half. The cleating is then fixed in position and the tool is passed between it and the flange, the protruding portion of the stud on the under side being inserted in the holes. A smart blow with a hammer on the upper half performs the punching.

FREDERICK CUSACK.



AN AUXILIARY DRIVING ARRANGEMENT.



A HANDY CYLINDER TOOL.

A Lathe Fixing.—The ordinary method of boring and turning steel shells or short cylinders, either from the forging or drawn tube, was considerably improved upon by the following arrangement, specially designed for the purpose. Fig. 1, an end elevation, shows the fixing-in section, which was bolted on the lathe saddle, the **T**-slot at the front being utilised for the purpose, and a stud **S** inserted in the carriage at the back. Two tool-holders held on the slides, carry a roughing and finishing tool, which operate upon the material simultaneously, the boring being accomplished at the same time. The boring-bar *B* in plan, Fig. 2, is placed in advance of the outside cuts, in order that the boring shall be finished before the turning reaches the chuck jaws. An end elevation of the slide and tool holder is shown at Fig. 3. G. H. RODWAY.

[We assume the shells were afterwards parted off or ended up in another chuck.—ED.]

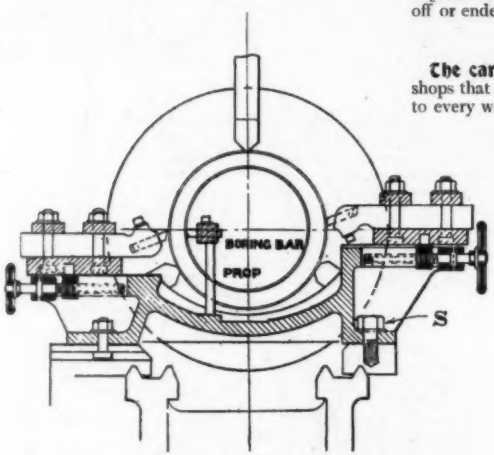


FIG. 1.—END ELEVATION.

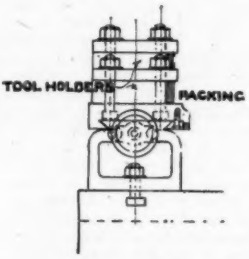


FIG. 3.—END ELEVATION OF TOOL HOLDER.

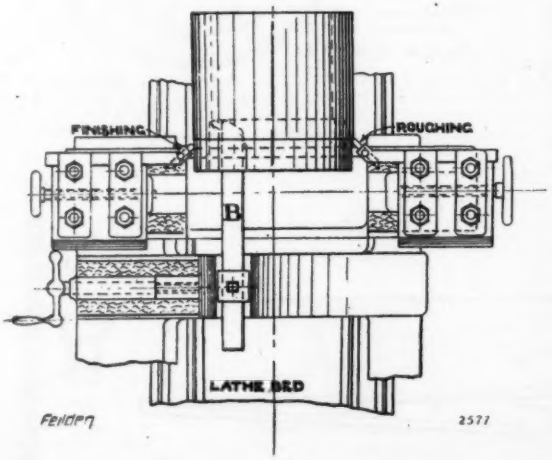


FIG. 2.—PLAN, SHOWING BORING BAR.

IMPROVED METHOD OF BORING CYLINDERS.

The care of Grindstones.—It is in a very few shops that the grindstone—that necessary adjunct to every works—receives the amount of attention that is necessary to keep it in good condition. This is especially the case where it has been superseded by the modern and faster-cutting emery wheel, which is naturally preferred to the slower action of the stone; yet, under proper conditions, it certainly retains its superiority for edge tools of fine temper. A few hints given for its preservation will place the grindstone on equal terms with the emery wheel, both of which have their respective uses.

(a) The tools to be ground should be free from oil or grease, which form smooth places, rot the grit, and destroy the abrading particles.

(b) Use a trueing device—there are plenty of good British make—and do not allow the stone to run eccentric and full of grooves before using it; make one of the handy-men in the shop responsible for the keeping of the stone in proper order, let him devote some little time to it, at least once a

week, and if a stone-dresser is not available, a couple of feet of 1 in. or 1½ in. gas-pipe is an excellent substitute.

(c) The stone, when trued up, should be slightly convex on the surface, and when in use water should be distributed over its surface from a drip-can, provided with a tap which regulates the supply, and is placed in a convenient position over the stone. This arrangement is far preferable and less dangerous than allowing the stone to be in contact with the water in the trough, as during the stopping of the machinery one portion of the stone becomes saturated and the other dry, which destroys the balance when running; also see that the trough is frequently cleared of the mud and stagnant water.

(d) In choosing stones, it generally follows that the freer the grit, the softer the stone, and it is a good plan when ordering a fresh one to send a chipping of the old stone, specifying whether the same or a different grade is required.

With attention given to these few details, we shall have a far more effective auxiliary than is found in the majority of shops.

J. R. KELLY.

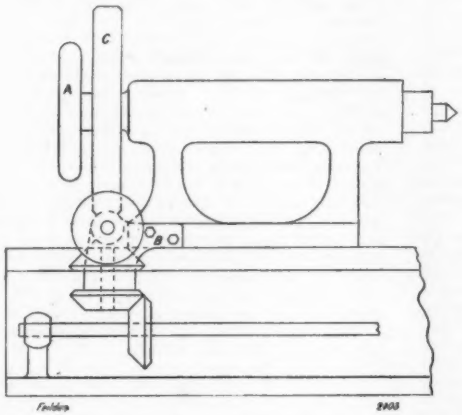


FIG. 1.—FRONT ELEVATION.

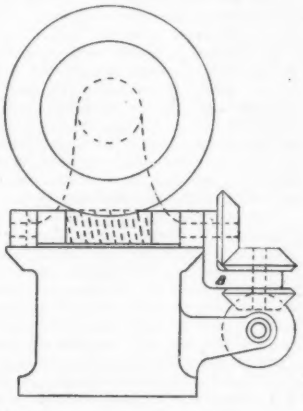


FIG. 2.—END ELEVATION.

TIME SAVING ARRANGEMENT FOR BORING SHAFTS.

Boring Shafts.—In modern engineering practice, and in the latest types of cable machinery, hollow shafting has superseded the solid form, by giving an increased strength proportionally with a larger bearing surface, and in nearly all cases a reduction of weight. The price of hollow forgings of high grade material frequently prevents their adoption, and necessitates the production of a hollow shaft by turning, and afterwards boring out of the solid stock. Without the aid of special machines this latter process becomes a rather arduous task, requiring constant supervision and some degree of strength to keep the boring tool up to its work. At Figs. 1 and 2 is shown an improvised arrangement fitted to the loose headstock of a 14-in. lathe, and by which a regularity of feed per revolution is obtained. Two brackets, *B B*, are attached by set screws to each side of the headstock, and, projecting beyond the end, carry a worm which gears into a worm wheel, *C*, fixed on the spindle screw of the headstock. A friction cone is keyed on the screw, and the boss of the worm wheel is coned to the same taper; by screwing up the hand wheel, *A*, against the boss of the worm wheel, the latter is held tight on the fixed cone on the screw. This device gives a good grip whilst the cutting remains free, but commences to slip as soon as the drill becomes galled or choked. Mitre wheels as shown, gearing up from the backshaft, impart motion to the worm. The ordinary taper shank twist drills are used, fixed in a boring bar—having a flat side—supported in a tool holder which is firmly gripped in the slide rest. Frequent lubrication by syringing with soap and water, resulted in the turning out of a good job with the minimum amount of attention. When half the distance had been bored, the shaft was reversed, a wrought-iron plug being fitted in the hole to prevent distortion by the gripping of the chuck jaws. Stays are fixed at suitable distances, and the shaft is cooled by a liberal supply of water carried round the outside by an endless belt of canvas, which conveyed it from a trough resting on the lathe bed.

"STRAND."

[NOTE.—With a modified form of bracket, *change wheels* could be substituted for the first two mitres; this arrangement would give a variation of speed.—ED.]

INDUSTRIAL PROGRESS

ENGINEERING NOTES AND COMMERCIAL INFORMATION

FROM ALL SOURCES.

CIVIL ENGINEERING.

Drainage Construction.—Notwithstanding the fact that the question of sewage and drainage has become of recent years a subject of almost constant discussion in the medical and technical press, it is an undeniable fact that even in the cities of the most enlightened countries, the sanitary arrangements continue to be of the most imperfect kind. Rarely, however, does the general public realise this, or take any interest in it, ere the cry of *Hannibal ante portas* is heard, *i.e.* ere some infectious disease makes its appearance in the country, and appears at the very gates of the town whose inhabitants have been sleeping in security, confidently believing that the municipal authorities have taken all the precautions necessary to prevent the spreading of contagion. In reality the very elements of hygienic engineering are frequently neglected in sewage and drainage systems for which enormous sums of public money have been spent, and even when the general arrangement is quite satisfactory its efficiency is utterly destroyed by the neglect of some detail, the faulty construction of which, like the weakness of a single link in a chain, renders the whole edifice useless. Among such details must be mentioned, as was pointed out by Mr. Gerard J. G. Jensen in his paper, read last month before the Society of Engineers, the construction and arrangement of drainage ventilation pipes. In the first place there exists the reprehensible fashion of using iron pipes. As pipes made of this metal invariably rust in their interior when coming in contact with moisture, they not only have constantly to be renewed, but are liable to become choked, and since in such condition they prevent ventilation, they render the system to which they are attached, however excellent it might otherwise be, absolutely insanitary. This danger is the greater since, owing to the fact that householders who have their drains regularly inspected are in the minority, their condition may escape notice for a long time, and in most cases is detected only when some case of illness draws attention to the matter. Another detail of importance is the selection of the locality where the drain air is to be liberated by means of such ventilation pipes. In some cases this liberation of foul air takes place in close proximity to the inhabited rooms of a house, and the blunder is not rectified ere an immense amount of mischief is done. To quote a case in point, Mr. Jensen stated that in a large school it was owing to the outbreak of follicular tonsilitis among the pupils, that his attention was drawn to the existence of bad drainage, and on examination it was discovered that the mouths of the ventilating pipes were situated quite near the dormitory windows. The wards of a recently erected sanatorium of the school he found to be under this same influence, and instead of having matters immediately mended, the persons responsible for the sanitary condition of the building appear inclined to wait and see whether harm will be done by the arrangement ere moving in the matter. In conclusion Mr. Jansen described a system of arranging waste-pipes which, ordinarily, are also placed in positions where they merely serve to do mischief, and it is to be hoped that his suggestions, or others of a similar kind, will be adopted, for there can be no doubt that the efficiency of sewerage and drainage is of far more importance in checking the course of contagious diseases than the most rigorous quarantine, since the latter can never be complete under our modern conditions of life, and as long as there are loopholes, however small, such quarantine is practically useless.

ELECTRICAL ENGINEERING.

Molecular Change of Iron under Magnetic Stress.—It appears that Mr. W. M. Mordey, while he was chief electrician to the Brush Company, was the first to make known the important phenomenon that iron, when it has been for some time subjected to continual strain in the form of changes of magnetism in transformer cores, becomes of greater magnetic reluctance, the result being that in distribution plants in which such transformers are employed, unless the pressure is increased at the primary terminals, the light given by the lamps connected to the secondary wires diminishes. A similar result will, of course, be observed with motors worked for the same service. All brands of iron are more or less subject to this ageing process, though, naturally, inferior brands feel it sooner than others, and there is but one remedy as yet known, namely, to make periodical tests, and whenever any signs of deterioration appear in a transformer, to take it out and have it re-made, re-annealing the iron plates.

Electrical Production of White Lead.—According to what appears to be reliable information, an American inventor has devised a method of manufacturing various metallic compounds, among them white lead, in an electric furnace. The essential features seem to be the heating of the metal by means of the electric arc and to bring it in contact in the molten state with gaseous vapours, suitable for producing carbonate of lead or any other of the lead compounds. The fumes produced in this way are then to be blown over into chambers, roofed with canvas or cloth covers of fine texture, and, on condensing, the white lead, it is said, falls to the ground as a fine dry powder, while the uncondensable gases gradually escape through the textile material forming the roof. If the results are as described, the process should find a wide adoption, as it does away with the laborious grinding, washing and drying operations accompanying up to the present the manufacture of white lead and similar products.

Tesla's Electric Light.—At last we have an authorised version of the characteristics of the electric light which Mr. Tesla intends to introduce into the dwellings of mankind within the near future, and to the perfecting of which he has devoted his genius and energy ever since he first demonstrated his theory before a number of scientific societies in Europe and in the United States. From this authorised version in the inventor's own words, which was published recently in the *New York Sun* and which, unfortunately, lack of space prevents us from quoting *in extenso*, we herewith give to our readers the essential details in the following:—Mr. Tesla had been struck many years ago by the idea of producing artificially those oscillations of enormous rapidity in the minute particles of matter in a very attenuated, *i.e.* gaseous, state, that after being communicated to the ether, are transmitted by its waves and reach us in the form of light. The theory itself had occupied the attention of some of the greatest scientists long before Mr. Tesla's time, but its practical application remained an unsolved problem, excepting some laboratory experiments foreshadowing a solution, the most brilliant and promising of which were those successfully carried out by the young Austrian inventor himself; while to find the means of producing and utilising these oscillations in a simple and economical manner for the production of light, and to make this light a commercial success, was the chief among the many difficulties that had to be overcome ere there could be a question of bringing this form of illumination within the reach of the people at large. This difficulty, Mr. Tesla informs us, has now been overcome, and he is able to produce light on the basis above indicated at a cheaper price than that which we have to pay for light derived from any of the sources used for illumination at present. Besides, however, the reduction of expenditure, the new light has, according to his statement, the advantage of being nearer in character to sunlight than any other form of artificial light so far known, and resembles this light not only in optic but also in hygienic effect. The lamps from which it is to emanate are glass tubes which may be bent in any ornamental way, but the form which Mr. Tesla himself ordinarily uses is a rectangular spiral of from twelve to fourteen convolutions, formed by a tube from twenty to twenty-five feet in length, which gives a total illuminating surface of from 300 to 400 square inches. The ends of this spiral are covered with a metallic coating, and furnished with hooks by which it can be suspended from the terminal of the source of the oscillations, while the interior of the tube contains a gas rarefied to a degree that has been found as the result of prolonged experimentation to give the best results. The general features of a domestic installation for producing this new form of light are the following: The electric current, continuous or alternating, is derived in the usual manner from the street mains, but instead of being directly conducted to the spiral-shaped lamp it first reaches an apparatus in which it is transformed into the required oscillations of high frequency, which reach the metallically-coated ends of the spiral and, entering the glass tube, produce in the interior corresponding oscillations of the same rapid sequence, which set the ultimate constituents of the enclosed gas into that violent oscillatory motion which, passing through space as ether waves, reaches the eye as light. There is no incandescence due to combustion of the gas, which, of course, would affect the life of the lamp and require its renewal. That lower form of waves known as heat waves is totally absent, or, at all events, not present in any perceptible degree, and the lamps remain unaltered for years, since practically the whole energy is converted into light. The economy, therefore, of this process of illumination, as far as the utmost utilisation of the source of light in the form of light is concerned, approaches the ideal, which, among other causes, is due, as Mr. Tesla states, to the comparative freedom of movement of the oscillating particles, due to the great attenuation of the gas. An almost equally important source of economy, moreover, is the fact that the total amount of light produced is rendered effective, because the light-giving body, being a gaseous and transparent form of matter, can throw out its radiations in every direction unimpeded, no solid centre or framework absorbing portions of it. Mr. Tesla's lamps can be manufactured in almost any size required; those that the inventor has been using for some years are, photometrically measured, of about 50 candle-power. A peculiarity of the light produced in these lamps is that in daytime it is scarcely noticeable, while at night the whole room is brilliantly illuminated; and equally remarkable is the circumstance that this light, resembling, as stated already, in it hygienic effect sunlight, ozonises the atmosphere, an effect which, however, can be at will either prevented entirely or increased to a degree just suited for a purification of the air, such as might be required in hospital wards. And last, but not least, the lamps may be fed by a single wire or even, under certain circumstances, the contents of the tube may be put

into the required oscillatory motion without the lamp being in any direct contact at all with the terminal supplying the current, as was shown by the inventor many years ago to the audience attending his lectures above alluded to. Mr. Tesla admits that he has not yet succeeded in dispensing with wires under all circumstances, but hopes to accomplish this ultimately, in which case it will be possible to carry the lamp from any one place in the room to another, like an ordinary kerosene lamp, and communicate to its contents through space the oscillations required to render them luminous. He has no difficulty, he states, in producing this ideal condition of illumination under the conditions created in his own room, but wishes to complete a number of improvements before making the details of his invention public.

Important Improvement in Planté Plates.—In the *Centralblatt für Accumulatoren und Elementenkunde*, Herr Weber describes the original and very useful construction of the electrode in the improved accumulator designed and manufactured by Messrs. Geoffroy & Delore at Clichy, near Paris, and by the Berlin "Accumulatoren und Electricitäts Gesellschaft," who have obtained the rights from the above-named French firm. This electrode, which can be used only as a positive, is a large surface plate of the Planté type, which, as practical electricians know, easily become distorted by bulging, especially when they have a straight core, and are liable to be torn through, owing to the differences between the potentials, caused by the expansions and contractions of both sides of the surfaces which result from the distortion. In order to prevent the latter, the centre of gravity is placed on the frame of the core and, as is stated in the patent specifications, the plates are provided on both sides with ribs or projecting flaps, while the core is formed in zig-zag waves, while on it are placed triangular blades, and the whole is so arranged, by a device that must be seen to be comprehended, that each blade can expand freely in all directions. This novel shape of the core gives the plate not only an extraordinary power of resisting impressions and bucklings, but also increases the surface to a size about seventeen times that of its projection, while, in addition, the manner of arranging the plates provides for a good circulation of the electrolytes. The definite size to be selected depends, of course, upon circumstances, but where the improved accumulator is to be used for stationary batteries for light and power plants, for which it is most suitable, the most serviceable dimensions for the plate are said to be a breadth of 22 cm., a height of 27 cm., and a thickness of 14 cm., which give to it a weight of about 5 kg. The capacity of such a positive plate, placed between two negatives, was determined by a series of tests carried out under the auspices of the Société Internationale des Électriciens at the Laboratoire Central d'Electricité. With a discharge current of 30 amp., an initial potential of 2 volts and a final potential of 1·75 volts, it was shown to be 32·9 amp.-hrs., while experiments made with a discharge current of 100 amps. and a fall of potential to 1·7 volts a capacity of 25 amp.-hrs. The solidity and durability of this improved accumulator was demonstrated by the fact that after a continuous charging and discharging with a current of 80 amps., no injurious effect on the plate was discovered. Such an extraordinary demand, of course, will hardly ever occur in practice. With a moderate demand, such as, for instance, a three-hour discharge, the capacity of the plate was shown to increase to 54 amp.-hrs. By means of special process, in which no chemicals that might cause injury are used, the complete formation of the plate is feasible within three days, and, according to Herr Weber, plates may be formed by this effective and very cheap process as rapidly and conveniently as grid plates filled with paste. In other words, it seems certain that the essential difficulties connected with the manufacture of Planté plates have been finally disposed of, for it is stated that this process, suitably modified for each special case, is applicable to the manufacture of Planté plates of all kinds of construction. The plates with cores of zig-zag form, however, will most likely supersede all others owing to the advantages above mentioned, and on the Continent a great number of storage batteries for light and power central stations have already been fitted with these plates, which in every way have justified the claims made for them.

MECHANICAL ENGINEERING.

Novel Method of Mottling Tin Plates.—A patent has recently been granted to Mr. William G. Brangham, of Niles, O., for quite an original process of mottling tin plates, which, according to the inventor, insures an even and uniform mottling of the plate at all points, giving them a thoroughly finished appearance. The essential features of the process are the following:—An air chamber is constructed, having an outer solid wall of hemispherical form and an inner wall concentrical with the outer wall and at some distance from it. This inner wall is provided with a number of slots extending over its curvature and running closely along its lower edge. From the top of the outer wall a tube descends containing a fan or blower. Beneath the inner wall is located a rack, the top and bottom of which contain grooves to receive the tin plates, and open at its top and longitudinal sides. The plates as they come from between the rolls, and after having been dipped in the melted alloy used in tinning, are at once taken by an attendant to the rack, wherein they are placed on edge at right angles to the slots in the inner wall. This having been done, air is forced into the air chamber by the fan or blower above-mentioned, and passing through the slots is brought in contact with the plates, the top, middle, and sides of which receive the same quantity of air under the same pressure. After being exposed in this way to the blast, and having during the operation been sufficiently chilled, they are at once taken out at

the other side of the rack. This process, it is stated, requires less than a minute for completely mottling the plates.

The Manufacture of Metallic Tubes and Bars.—At a meeting of the Society of Engineers last month, Mr. Perry F. Nursey, past-president of the society, after pointing out the benefits derived by the metallurgical industry from the results of the theoretical and practical inquiries into the flow of metals, proceeded to describe the processes and apparatus employed in the manufacture of bars and tubes by forcing metal through dies by pressure. This description was introduced by a short digression into the history of metal tube manufacture, in which the author stated that some years ago, at Bath, he had come across water-pipes made by the Romans. These pipes measured about 18 ins. in width and 4 ins. in depth, and were made from a dished strip of lead, which constituted the top, whilst a flat strip, having its edges turned up over the edges of the upper strip, formed the bottom. The metal for these pipes probably was obtained from the mines in the Mendip Hills, where lead pigs have been found bearing the stamps of the Roman emperors Claudius, Vespasian, and Hadrian respectively. In later times lead pipes were made by drawing or rolling cylinders of lead, until the required diameter was attained, on a mandril of the thickness of the bore, or by bending sheet lead over a mandril and soldering the edges. Finally a more satisfactory method came into use, by which molten lead is placed in a heated container and permitted to cool down until a state of plasticity has been attained, in which condition the metal is forced through a die by hydraulic pressure. By this method pipes of any desired length can be produced. Mr. Nursey described an adaptation of this method seen by him at the Farringdon Works of Messrs. Pontifex, of Shoe Lane, London, and an improved pipe-press of Mr. Alexander Wyle manufactured by Messrs. Wilson & Sons, of Johnstone, Glasgow, which is greatly in advance of the ordinary lead pipe press. In the later processes in which this improved pipe press is used the container is jacketed and steam-heated, instead of being, as is ordinarily the case, kept hot by a fire or by a ring of gas jets. Mr. Wylie's pipe press finds extensive employment in the making of tubes to cover telegraph cables, which by his process pass horizontally through a core, and the process of covering is rapid, continuous, and effective; while when the ordinary pipe presses were used the cable was attached to the core and the pipe as produced pushed forwards over it, which gave but unsatisfactory results, the chief drawback being that the cable was frequently damaged by heat, nor were the results much better by cooling the pipe by cold water ere it reached the cable. A still further improvement in the lead pipe manufacture was introduced by Mr. Alexander Dick, the inventor of the so-called Delta metal, who inaugurated the extrusion process, by which all kinds of bars—from a simple round wire to complex sections which could never have been produced by rolling—as well as tubes of any section, can be made by forcing the metal, heated to plasticity, through dies by means of hydraulic pressure. The most important feature, however, in Mr. Dick's process is that he has succeeded in overcoming the difficulties in the way of applying this method to metals having a far higher resistance than lead, and possessing a far higher temperature when in a condition to press them through the die. Thus, for instance, lead, with its melting point at 620 degs. Fahr., is plastic at a comparatively low temperature, while copper or copper alloys, with their melting points at about 2,000 degs. Fahr., have still a temperature of about 1,000 degs. Fahr. when plastic. In Mr. Dick's ingenious apparatus the hot metal is charged into a horizontal container at a point of which is the die, through which it is pressed by hydraulic power applied at the rear end, and issues in the form of either bars or tubes. These extruded bars or tubes are of a superior quality of metal, possessing increased density and being perfectly homogeneous in character throughout. When tested for tensile strength they give much higher results than rolled bars or tubes of the same metal, and they work best in the lathe or the screwing machine at speeds twice, or even three times, as great as those suitable for the ordinary metal.

Hardening of Milling Cutters.—An American contemporary gives some useful hints regarding the tempering of milling cutters:—The cutter should be heated in the fire of a gas furnace, or in molten lead. The vital point is to obtain an even temperature of the required degree. If lead is used, the drawback of its sticking to the tool will be avoided by taking care that the lead is pure, and by placing an abundant quantity of broken charcoal on top to prevent oxidation. Should this not suffice, the cutter ought to be coated with salt before plunging it into the heating bath of molten lead, which is easily accomplished by warming the tool until it assumes a blue hue, and then dipping it into a solution of salt in water. The cutters, after being hardened, may be cooled in clear water or brine, at a temperature suited to the character of the tool, *i.e.* its greater or lesser delicacy. With some heavy cutters the water may be ice cold, while for thin and delicate cutters, it would be better to use water at the temperature of blood heat or even higher. The cutters should be moved from the cooling bath as soon as the teeth have been hardened sufficiently, and then be immediately immersed in oil, to remain there until quite cooled. By doing so the heat is equalised, and the antagonism of unequal strain, which often is the cause of cracking, is avoided. The temper may be drawn in oil by aid of the thermometer, or, in the ordinary way, by heating a rod to slip into the hole. Instead of a plain rod it is better to use one with an enlarged section or collar which holds the heat.

New Moulding Material.—A new moulding material is described in the American trade-papers

which, at all events, deserves to be tried. A quantity of plaster of Paris is mixed with water until the elements have become thoroughly combined. Another paste is formed by adding water to mica scales of finely ground mica until a stiff but pliable mass has been obtained. To three parts of the plastic gypsum one part of the mica paste is then added and the whole is thoroughly worked and kneaded until the mass is homogeneous throughout. This combination is then cast on the pattern on which the mould is to be made, and the mould is placed in a drying oven and subjected to a moderate heat. After this it is ready for the casting.

Small Steel Castings.—A metal of very satisfactory character for making small steel castings is said to be obtainable by using the so-called Tropenas process. The essential features of this process are the use of special converters in which pig-iron and selected scrap, previously melted in a cupola, are subjected to an air blast of 3 lb. to 4 lb. pressure per sq. in., directed horizontally across the top of the molten bath. In this way intense heat is developed by the combustion of the metalloids contained in the pig-iron, and after a period of from 16 to 20 minutes, the length of time depending on the quality of the charge used, there remains in the converter a bath of almost pure pig-iron. In order to bring up the silicon, manganese and carbon contents to the specified proportions, ferro-manganese or ferro-silicon, or both, must be added, and the molten mass is ready to be drawn off into a ladle and poured. The fluidity of the metal obtained in this manner is said to be much greater than that produced in any other way.

A Successful Solar Motor.—The idea of utilising the artificially concentrated rays of the sun in the service of man is of remote antiquity. The achievement of Archimedes, who is said to have burned, over 200 years before the beginning of the Christian era, a fleet of hostile ships by means of a gigantic lens is familiar to most of us from our school-days. The use of reflectors instead of lenses for producing high degrees of heat by concentrated sunlight was for some time rendered difficult by the obstacles in the way of constructing large concave mirrors. It was overcome, however, by having the surface of a concave mirror covered with small pieces of glass or mirrors having a common focus, the total heat thus generated being equal to that collected by each separate glass, multiplied by the number of glasses. Some centuries ago, these contrivances appear to have had for their object to blind or dazzle the enemy; but apparently little success was thus obtained, and the devices had no other value than that of ingenious curiosities. Intended for more peaceful objects were the burning mirrors constructed some years ago in France; one of them 4 ft. in diameter, built by an inventor named Vollette, developed an amount of heat sufficient to melt cast-iron in 16 secs. This instrument was eclipsed later by a lens constructed by an Englishman named Parker, who succeeded in melting by means of it cast-iron in three seconds, and fusing granite in one minute. With the progressive annexation by civilised countries of the bulk of hitherto unknown portions of the globe, regions in which sunshine is almost perpetual came into possession of energetic races whose utilitarian turn of mind soon realised the possibilities of the heat there wasted or consumed merely in destructive action, and who realised that it might take the place of the lacking fuel to convert water into steam for driving motors that would do the work which man in torrid regions shrinks from performing with his own hands. Sir William Herschel experimented with this object in view in Africa, and Captain Ericson succeeded in constructing a solar motor which he exhibited in 1884 in New York. It was, however, reserved for a dweller in Southern California — the region in which during recent years so many marvels have been accomplished by man in transforming an arid desert into a luxurious Eden by forcing elementary forces of Nature into his service—to construct a really practical sun motor which daily accomplishes useful work at the ostrich farm at Pasadena, near Los Angeles. The heat to transform the water into steam is furnished by a gigantic reflector, consisting of a concave glass mirror in which a central portion, 15 ft. in diameter, is lacking, and which at its outer margin has a diameter of 33 ft. 6 ins. The reflecting surface consists of 1,788 separate mirrors, all concentrating the rays reflected in them upon the same focal point. The motor is light and elegant in appearance, supported by shafts that seem delicate and slender, but in reality are strong enough to resist a wind pressure of 100 miles an hour, and though the structure weighs many tons it is so carefully adjusted as to move with the greatest ease. The true focus is shown by an indicator, and the gigantic reflector, which must directly face the sun, is constantly kept in motion by clockwork, every necessary change being performed automatically. About an hour after the first rays are collected, the boiler arrives at a temperature of white heat, and the steam gauge registers 150 lbs. The steam is transmitted from the suspended boiler to the engine by being forced through a flexible tube of phosphor-bronze, and returns again to the boiler from the condenser in the form of water, so that the latter is automatically kept full. All operations, including the oiling of the apparatus, are performed without the aid of an attendant, and the apparatus runs from sunrise to sunset without interruption. The work for which this ingenious sun-motor is used consists in pumping water from a well for irrigation purposes, lifting fourteen hundred gallons per minute by the expenditure of about 10 h.p.; but it can develop 15 h.p. if desired. Its success is almost certain to result in the adoption of such motors in other regions of the Western States of North America, where an abundance of sunlight and scarcity of fuel are the characteristic conditions of the country.

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In this section is presented every month a concise précis of the contents of the leading organs of the technical press and of the proceedings of the learned societies throughout Great Britain, the Continent, and America, and also, in a summarised form, the subject matter of the more important articles appearing therein.

This systematic record should prove of the greatest value to those of our readers interested in one or more specific sections of technology, trade or economics, or to those who have insufficient leisure to peruse the large number of publications now appearing.

In most cases where publications are not readily procurable, with the exception of Transactions of the Learned Societies, copies of the articles can be supplied on application by remitting 7d. Should any of our readers desire further information we shall be happy to supply it.

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ARCHITECTURE AND BUILDING.

1. Construction and Design.

Exhibition Buildings.—*The Paris Exhibition, 1900.* This is a lecture by Mr. E. W. Wonnacot, the Cates Prizeman, delivered before the Architectural Association, containing a somewhat belated though very interesting account of the architectural features of the Paris Exhibition last year, showing that the author did well employ the opportunity afforded him by his success in the prize competition.—*Builder*, March 9th, 1901, p. 237.

Lodging Houses.—*Rowton Houses.* This is a paper by Mr. H. B. Measures, read before the Architectural Association, in which the author describes the Rowton House in Newington Butts as typical of the system, and shows the excellent accommodation offered to guests at a nominal fee, which, however, suffices to pay in full for all he obtains.—*Builder*, March 23rd, 1901. pp. 285-291. (Ill.)

2. Heating and Ventilation.

Ventilating Plant.—*Ventilating and Heating the Boston Music Hall.* Description of a very interesting heating and ventilating plant, peculiarly noteworthy for its large proportions and generous basis on which the air supply has been calculated, as well as for the fact that it was designed together with an isolated electric lighting plant.—*Engineering Record*, March 2nd, 1901, pp. 205-207. (Ill.)

—— *Ventilating and Heating in a Paterson, N.J., School House.* The article deals with a ventilating and heating apparatus for warming a 24-room school building in Paterson, New Jersey, U.S.A., by a system of hot air distribution occupying a minimum of area and volume.—*Engineering Record*, March 9th, 1901, pp. 231, 232. (Ill.)

3. Plumbing and Gasfitting.

Plumbing.—*Plumbing in the Manhattan Hotel, New York.* This is a description mainly of the water-supply system recently introduced into an annexe of the sixteen-storey steel-skeleton building above named, the chief interest of which consists in the way in which the new plant is brought into harmony with the plant in the main building.—*Engineering Record*, March 16th, 1901, pp. 258, 259, and March 23rd, p. 262. (Ill.)

Sanitary Fittings and Plumbing.—*Bath Wastes and Overflows.* The author, after having pointed out that in the improvements made in this direction the tendency has been to make the various parts more accessible for cleansing, to increase the size of the waste outlet, and to render the waste-pipe and trap self-cleansing, describes a number of typical kinds of overflows. — *Builder*, March 23rd, 1901, pp. 295, 296.

4. Miscellaneous.

Neglect of Buildings.—*Dilapidations.* By W. J. Jennings, F.S.I. This is a paper read by the author before the Society of Architects on March 21st, 1901, in which the general principles applying to the common law of liability to repair, as applying to a tenant for years and a tenant for life, are fully discussed, the bulk of the discussion being devoted to the principles and practice of surveying and valuing dilapidations to buildings arising under the common forms of covenant entered into by landlord and tenant.—*Architectural Record*, March 27th, 1901, pp. 135-140.

CIVIL ENGINEERING.

1. Bridges.

Bridge Construction.—*Moving the Hackensack River Drawbridge.* Description of a very ingenious and instructive operation consisting in replacing two fixed spans and a draw-span nearly 200 ft. long of the bridge of the Delaware, Lockawauna and Western Railway, which crosses the Hackensack River at Hoboken, N.J., U.S.A. This was done on a Sunday, with scarcely any interruption to railway or river traffic, and the *modus operandi* is clearly outlined in the article.—*Engineering Record*, March 9th, 1901, pp. 218, 219. (Ill.)

—— *The Reconstruction of the Glasgow Bridge on the Chicago and Alton Railway.* By W. D. Taylor, M.Am.Soc.C.E. This contribution, by the Assistant-Engineer of the above-named railway, in charge of the bridge site of the reconstruction, contains an outline of the very interesting work performed in rebuilding what appears to have been the first all-steel bridge built in the United States.—*Engineering Record*, March 16th, pp. 241-46. (Ill.)

—— *The X Bridge at Mans, France.* The article contains a short account of a cheap and very original structure, both as regards general plan and details, *i.e.* a bridge carrying a line of electric cars and a line of steam tramcars across the River Sarthe, just below the old Ysoir bridge. The electric road crosses the river at a skew of nearly 20 degrees, and the steam road crosses at about the same skew in an opposite direction, the two lines intersecting at the middle of the river.—*Engineering Record*, March 23rd, 1901, pp. 275, 276.

—— *The Brooklyn Caisson for the Manhattan Brooklyn Bridge.* The bridge referred to is to be the

third across the East River, N.Y. Its construction was authorised by the New York Board of Improvements on Jan. 8th, 1900, and bids were opened for the Brooklyn Tower, the details of which, notably those of the caisson, are given in this article.—*Engineering Record*, March 9th, 1901, pp. 194-97. (Ill.)

2. Canals, Rivers, and Harbours.

Port Construction.—*The Port of Bristol.* An article on the subject, in which the author, after pointing out the many natural obstacles that were in the way of making Bristol a seaport, refers to the total transformation of its natural features accomplished for that purpose, gives a history of the work done in the course of centuries, and finally enters upon the details of prospective improvements, notably those recommended in the report of a committee of inquiry, and, after acceptance by the Corporation, included in a Bill known as the Bristol Docks and Railway Act, 1901.—*Builder*, March 30th, 1901, pp. 307-11.

3. Miscellaneous.

Tunnels.—*Tunnelling with a Roof Shield at East Boston.* The article deals with the method of operating a large roof shield, which, together with the heavy concrete lining, form the most interesting features of construction of the East Boston shaft of the tunnel which is to run under Boston Harbour.—*Engineering Record*, March 23rd, 1901, p. 273.

ELECTRICAL ENGINEERING.

1. Electro-Chemistry.

Accumulators.—*Recent Progress in Accumulator Manufacture.* The author first speaks of the defects of accumulators, the greatest of which is the disintegration of the active material in the positive plates and the loosening of the paste. One of the means of preventing this is to shut in the paste on both surfaces, this is the improvement represented in the "Barbier Cell." Another method consists in supporting the paste by porous earthenware separators, which is the principle underlying the construction of the "Taipo" Accumulator. Another cell described in the article is that manufactured by the New Phœnix Company of France, in which a cylindrical porous pot is employed, and the positive and negative electrodes are placed concentrically. A third method of preventing disintegration described by the author is that of making the metallic support contract and expand *with* the active material. This is perhaps best done in the "Blot" and "Sherrin" Accumulators. Besides these a number of other improved cells are described. (To be continued.)—*Electro-Chemist and Metallurgist.* March 1901, pp. 70, 71.

Aluminium.—*Aluminium Welding.* This is a description, first, of the process invented by W. C. Heraens, of Hanau, Germany, consisting in the heating of the metal until it becomes plastic, and in hammering the end-pieces to be joined together; and, second, of the Cowper-Coles process, by which the metal can be bent in various shapes without any signs of fracture being discovered. This latter process is still kept a secret, but it is known that it is not electric, nor is any flux or solder used for the purpose. *Electro-Chemist and Metallurgist*, March, 1901, pp. 70, 71.

Organic Compounds.—*Application of Electrolysis to Organic Compounds.* By J. T. Hewitt, M.A., D.Sc., Ph.D., Professor at the East London Technical College. This is a continuation of a contribution referred to in this section of the April issue of FEILDEN'S MAGAZINE.—*Electro-Chemist and Metallurgist*, March, 1901, pp. 68, 69.

Applications of Electrolysis.—*An Electrolytic Process for the Manufacture of Parabolic Reflectors for Search-lights and Locomotive Head-lights.* By Sherard Cowper-Coles. After a few words of introduction, the author describes the conditions necessary to obtain from a parabolic mirror a parallel beam of light, especially where the electric arc is used, discusses the superiority of metallic reflectors over glass reflectors, and the difficulty of constructing a true metallic reflector, and refers to the historical attempts to overcome this difficulty. He finally enters upon a full account of an electrolytic process devised by himself, in which he gives the details of the various operations required, such as silvering the glass mould, the use of the copper depositing vat and spinning gear, the work of flashing the mould, the use of the stopping and baffle rings, the formation of "trees" and "nodules," the expanding of the backing from the mould, etc. (To be continued.)—*Electro-Chemist and Metallurgist*, March, 1901, pp. 61-66.

Electrolysis.—*Estimation of Metals by Electrolysis.* By Charles Nathan, B.Sc. Part II. After indicating the signs by which we can ascertain whether the process has been completed, he proceeds to explain the methods to be used for the estimation of all the better-known metals. The present instalment deals with the electrolytic examination of copper, cadmium, bismuth, manganese, lead, silver, mercury, gold, platinum, antimony, tin, arsenic, iron, zinc, nickel, and cobalt. (To be continued). — *Electro-Chemist and Metallurgist*, March 1901, pp. 59, 60.

—— *Electrolysis and Colour.* By the Editor of *The Dyer.* The author describes how to produce an insoluble coloured metallic salt that can be used as a pigment, such as vermilion, cadmium yellow schule, green, etc. He points out that the chief use of electricity in pigment-making is, of course, in the manufacture of white lead, for which numerous processes have been recommended, most of which have utterly failed, and he finally gives an outline of the electrolytical manufacture of various dye-stuffs, such as aniline black, aniline blue, alizarine, Congo red, various orange dyes and lakes.—*Electro Chemist and Metallurgist*, March 1901, p. 67.

Oscillators. — *A New Oscillator for Stationary Electrical Waves.* By D. Bernouilli. Description of the Blondlot-Coolidge oscillator, which the author recommends to those demonstrators in colleges who wish to show the presence of nodes and loops in the waves, and dispense with the use of the air-pump employed by Lecher.—*Electrician*, March 8th, 1901, pp. 737, 738.

Ions.—*Influence of Magnetism upon Ions.* By O. Urbasch. This is a digest of a dissertation on the subjects submitted to the University of Giessen, and contains the results of an inquiry into the influence of magnetism upon the electrolytic separation of paramagnetic and diamagnetic metals; the movement of electrolytes in the magnetic field without employing an external difference of potential; movement of the ions by the medium of solution and with the aid of magnetism; together with some general remarks on the subject of investigation.—*Zeitschrift für Elektrochemie*, March 28th, 1901, pp. 527-30.

2. Electric Lighting.

Electric Lighting.—*Electric Illumination.* Synopsis of a lecture delivered on the above subject by Dr. Louis Bell at the station of the New York Gas, Electric Light, Heat and Power Company, Duane Street, New York City, before the New York Electrical Society, on Jan. 30th, 1901.—*Electricity* (New York), Feb. 6th, pp. 75-77.

—— *Electric Lighting for Railway Cars in Germany.* This contribution contains comments on the causes of a deplorable railway accident at Offenbach-on-Main, Germany, which is attributed to an unsatisfactory system of gas-lighting, and refers to the project of substituting electric light in railway cars, experiments being made for the purpose at Berlin with the Stone system of electric car-lighting.—*Electricity* (New York), March 13th, 1901, p. 156.

3. Power.

Electrical Machinery.—*The Utilisation of Electrical Machinery in Coal Mining.* By W. P. Mountain. The author covers considerable ground within the limited space of a magazine article, but although being obliged to curtail his comments, succeeds well in demonstrating that, in order to keep a colliery in a condition to produce with the necessary economy in labour and time, it is absolutely necessary nowadays to make use of electrical machinery.—*Electrical Review*, Feb. 8th, 1901, pp. 239-43. (Ill.)

Electricity Works.—*Fulham Electricity Works.* Description of a very interesting and up-to-date supply installation, erected at an expenditure of £100,000, or, with the addition of apparatus for coal handling, meters, well-sinking, extra foundations, and engineering expenses, of £108,000. The lighting plant in itself is of a capacity sufficient to supply 30,000 8 c.p.—*Electrical Review*, Feb. 15th, 1901, pp. 279-86. (Ill.)

Generators.—*Direct-Current Generators.* By Sidney H. Short. The author, after a general survey of the gradual evolution of the modern types of dynamo-electric machinery, dwells on the essential features and efficiency of direct-current generators, with the intention of demonstrating the feasibility of more nearly standardising this class of electrical machinery.—*Electrical Engineer*, March 29th, 1901, pp. 446-48.

Power Plants.—*A Double-Current Power Plant.* By Frank C. Perkins. Description of the plant of the Quebec Railway Light and Power Company at Montmorency Falls, Canada, comprising a Westinghouse double-current generator, directly connected to a Victor turbine wheel, the generator being a 600 kilo-watt machine, and supplying a 500-volt continuous current to the local railway feeders from the direct-current side and a 400-volt two-phase current from the alternating side.—*Electricity* (New York), Feb. 13th, 1901, pp. 90, 91. (Ill.)

—— *The Trafford Park Power Works.* Description of what appears to be the first electrical station to be worked in England with the special object of supplying power in bulk to large manufacturers—*i.e.* that of the Trafford Power and Light Supply, Ltd., which is approaching completion, and, in fact, is in working order already, but not yet in a condition to produce power as economically as it will ultimately be able to do.—*Electrical Engineer*, March 15th, 1901, pp. 366-71, and March 22nd, pp. 402-5. (Ill.)

Transformers.—*Westinghouse "O. D." Transformers.* Description of the features of a new transformer recently placed upon the market by the Westinghouse Company, which is not so much a novelty as rather an improved transformer of the well-known Westinghouse type, in which the general principles underlying the ordinary type are maintained, but the details are perfected.—*Electrical Engineer*, March 29th, 1901, pp. 440-72. (Ill.)

4. Telegraphy and Telephony.

Telephone Lines.—*A Few Notes on the Construction of Telephone Lines in Norway.* By "Busyback." The author gives to his readers some interesting facts, collected during a holiday in Norway, regarding the outside appearance of the telephone lines in various towns of that country, which permits us to find an explanation for the great cheapness of telephone instalments and the very extensive use made of telephones in Norway.—*Electrical Review*, Feb. 8th, 1901, pp. 223—25. (Ill.)

Wireless Telegraphy.—*M. Guarini's Wireless Telegraph Experiments in Belgium.* Having satisfied himself that successful wireless telegraphic communication could be maintained between Malines and Brussels on the one hand, and Malines and Antwerp on the other, M. Guarini recently tested his repeater with the object of re-transmitting automatically to Antwerp the signals received at Malines from Brussels. The article describes the, unfortunately, not very successful results thus obtained.—*Electrician*, March 22nd, 1901, p. 819.

—— *Multiplex Wireless Telegraphy with Tuned Apparatus.*—Digest of a very interesting lecture delivered in the presence of the German Emperor and many high officials, at Berlin, by Professor Slaby, describing this ingenious system of wireless telegraphy.—*Electrical Review*, March 15th, 1901, pp. 439, 440, and March 22nd, pp. 485, 486.

5. Miscellaneous.

Aluminium Wire.—*Aluminium Mains in Practice.* This contribution contains some interesting data collected on an installation of aluminium wires as mains of an overhead system of distribution, used in the small town of Northallerton, in Yorkshire, owned by the Northallerton Electric Light and Power Company, Ltd., the station being inaugurated in 1899, and being erected with the intention of keeping first cost as low as possible.—*Electrical Review*, March 8th, 1901, pp. 309, 310.

Conducting Wires.—*Phono-Electric Wires.* The communication deals with trolley wires and wires for other electrical purposes placed upon the British market by Messrs. Maguire & Baucus, of 5, Warwick Street, Holborn, and manufactured by the Bridgeport Brass Company in the United States, well known by their improvements in hard-drawn copper-wire. The material from which the company manufactures this new kind of wire, called by them Phono-Electric Wires, is a new alloy of copper possessing many valuable qualities, and is becoming rapidly popular among electric engineers in charge of large supply stations.—*Electrical Engineer*, March 22nd, p. 416.

Induction.—*Induction Experiments.* By M. Guarini. The author describes a number of experiments made by him to show that it is possible to obtain in an induced circuit a current producing the same effect as a continuous current, and develops from the results obtained an interesting theory, which, however, seems to be rather of purely scientific value and of but little import as far as electrical engineering is concerned.—*Electrical Engineer*, March 29th, pp. 442-45.

MARINE ENGINEERING AND SHIPBUILDING.

1. Merchant Vessels.

Coast Liners.—*Steamship "Grecian" of the Boston and Philadelphia Steamship Co.'s Fleet.* Description of a good example of a typical American coast-line steamship. The ship was built at the yards of Messrs. Harlan & Hollingsworth, at Wilmington, Del., U.S.A., for the above-named steamship company.—*Marine Engineering*, Feb., pp. 69-75. (Ill.)

2. Pleasure Craft.

3. Equipment and Machinery.

Equipment of Steamships.—*Kirkaldy's Patent Marine Specialities.*—II. Description of fresh-water distiller for using high-pressure boiler steam to produce cold, fresh drinking-water, known as the "Compactum," a feed-water filter of the pressure type, having the same trade designation, and finally a "Compactum" auxiliary surface condenser, all designed and constructed by Messrs. John Kirkaldy, Ltd., of 101, Leadenhall Street, London.—*Steamship*, April, 1901, pp. 369-71.

Boilers.—*Water-Tube Boilers.* This is a reprint of the Interim Report of the Admiralty Committee appointed to consider certain questions respecting boilers for naval purposes.—*Steamship*, April, 1901, pp. 378, 379.

4. Docks.

Docks.—*The New Dry Dock at Baltimore.* Description of a new timber dry-dock which has recently begun to be constructed at the yards of the William Skinner & Sons' Shipbuilding and Dry Dock Company of Baltimore, and is well progressing. It will have a length from head of dock to outside of apron of 625 ft., a width at the bottom of 60 ft., and a width at top dock of 125 ft., while the depth of water on inner sill at low tide will be 22½ ft., and at high tide 25 ft.—*Engineering Record*, March 16th, 1901, pp. 248-50. (Ill.)

Dry Docks.—*The Portsmouth Dry Dock.* In 1898 the Congress of the United States made an appropriation for the construction of four timber dry-docks in the navy yards of Boston, Portsmouth, League Island, and Mare Island. It was afterwards determined to build the two first of concrete and granite, the contract for Portsmouth being let, in October, 1899, to Mr. John Peine, New York, and operations began in the following November. The article gives a general outline of the work to be done and of the progress made up to date.—*Engineering Record*, March 25th, pp. 270-72. (Ill.)

5. Miscellaneous.

Shipyards.—*Some Remarks on the Commercial Organisation of Shipyards.* A paper, by Mr. Walter Scott, read before the meeting of the North-East Coast Institution of Engineers and Shipbuilders, held at West Hartlepool on March 2nd.—*Steamship*, pp. 388-90.

MECHANICAL ENGINEERING.

1. Boilers, Furnaces and Fuel.

Boilers.—*The Application of Mechanical Draught to Stationary Boilers.* Abstract of a lecture by Mr. Walter B. Snow, in which the author enters upon a comparison between the chimney and the fanblower, as regards draught production, and shows that mechanical draught costs far less for installation than the chimney; is essential for the most complete utilisation of the waste heat of the flue gases; makes it possible to burn low-grade, *i.e.* cheap fuel, and to readily meet sudden demands for more steam; and is capable of adaptation to almost all conditions, whether as a substitute for or an auxiliary to the chimney. *Engineer* (Cleveland), Feb. 1st, pp. 57, 58.

Furnaces.—*Boilers, Furnaces, and Economy. II.* By O. D. Cotton. The author in this second contribution on the subject discusses the forms of furnaces and their efficiency, and the various methods of firing, but warns his readers not to confuse theoretical and practical results.—*Engineer* (Cleveland), Jan. 1st, pp. 2, 3.

2. Compressed Air.

Air Compressor.—*A New Riedler Air Compressor.* Description of one of five Riedler Compressors, recently completed by Messrs. Fraser and Chalmers, of Chicago, to be used for the Consolidated Rand Gold Mines of South Africa. These compressors are of the Standard type adopted by the Rand Mines, Ltd., South Africa, and designed for a working pressure of 120 lbs. per sq. in., with a rotating speed of 65 revolutions per minute.—*Engineering Record*, Jan. 26th, 1901, pp. 82, 83. (Ill.)

3. Engines and Motors.

Automobiles.—*Motor Cars in Paris.* Editorial dealing with the annual show organised by the Automobile Club of France in the Grand Palais, in which the writer points out that the show, which is undoubtedly the greatest manifestation of the motor carriage industry that, so far, has taken place, in the extent of the exhibits as well as the character of the vehicles, gives a striking impression of what has been done in the new industry during the past three or four years.—*Engineer*, Feb. 15th, 1901, pp. 157, 158.

—— *Motor Cars in Paris.* While in the above article the writer dealt with the general features of the industry and described the evolution of the new vehicle at the recent Paris show, he enters in the present article more fully into the details of mechanical construction, and the progress so far attained.—*Engineer*, Feb. 22nd, 1901. (Ill.)

Traction.—*Traction Engines.* Short description of a new pattern of traction engine constructed by Messrs. Aveling & Porter, Ltd., of Rochester, and exhibited by them at the last Smithfield show. Although modelled on the firm's usual type, it contains some novel features.—*Engineering*, Jan. 25th, p. 109. (Ill.)

Triple Expansion Engines.—300 *Horse-Power Triple-Expansion Engine.* Description of a vertical engine of the above class, constructed by Messrs. Escher, Wyss & Co., of Zürich, which formed one of the noteworthy exhibits of that firm in Paris last year.—*Engineering*, Jan. 18th, 1901, p. 89. (Ill.)

4. Power and Transmission.

Pressure Pump.—*The Smith-Vaile Direct-acting Pressure Pump.* Short description of one of the largest of the new line of compound direct-acting pressure pumps built by the Stillwell-Bierta and Smith-Vaile Company, of Dayton, O., U.S.A., for the Columbian Gold-Mining Company, Oregon, and will be operated condensing.—*Engineering Record*, Feb. 9th, p. 135.

5. Machine Works, Shops, and Foundry.

Flasks.—*Foundry Flasks.* Comments on a communication by Mr. John Sands, of Manchester, printed in the *Mechanical World*, and referring to the paper on "Foundry Flasks," by the late Mr. Eli F. Pearce, read at the Chicago Convention, in which the writer insists, in opposition to Mr. Sands, on the value of light wooden flasks.—*Foundry*, Feb. 1901, pp. 235, 236.

New Foundries.—*New Steel and Iron Foundries of the Sargent Company.* These foundries were recently erected at Chicago Heights, Ill., U.S.A., and are fitted in the most modern style, being splendidly adapted for the production of both classes of work. The process adopted for small castings is the Tropenas process, which is described in the article, and by which castings of excellent quality are obtained; hydraulic power, electricity, and compressed air are used in the foundries, whichever power is most suitable, and the latest methods are used in every case.—*Foundry*, Feb., 1901, pp. 237-41. (Ill.)

6. Tools.

Drilling Machine.—*Radial Drilling Machine.*—Description of a machine as above mentioned, constructed by Messrs. Ward, Haggas & Smith, of the Eastwood Tool Works, Keighley, and distinguished, among other improvements, by its handiness.—*Engineering*, Feb. 8th, 1901, pp. 171. (Ill.)

—— *Horizontal Drilling and Boring Machine.*—Description of a machine constructed by the Atlas Engineering Company, Levenshulme, Manchester, giving details of construction and essential dimensions.—*Engineering*, Feb. 15th, p. 203, (Ill.)

Machine Tools.—*The American Machine-Tool Section at Vincennes.* Description of the very successful exhibit of American machine-tools at Vincennes, in what might be called a gigantic workshop some 37,000 ft. in area, all but 10,000 ft. of which was occupied by machine-tools in motion. This arrangement resulted in an emphatic advertisement of American tools and in large orders from employers of machinery, not only in France but from every quarter of the globe. The article gives an account of all the most noteworthy exhibits.—*Engineering*, Jan. 4th, 1901, pp. 6, 7, and Jan. 11th, 1901, pp. 34, 35.

—— *The Early Machine Tools of Henry Maudslay.* By W. A. S. Benson. Very interesting article on the tools invented and constructed by the first Henry Maudslay, some of which were actually still in working order when the famous engineering firm in Lambeth ceased to exist last year.—*Engineering*, Jan. 18th, 1901, pp. 65, 66, and Feb. 1st, 1901, pp. 134 36. (Ill.)

—— *Some Machine-Tools* (*Illustrated*). Description of several machine-tools of British make, exhibited at Paris last year by Messrs. George Richards & Co., with works at Broadheath, comprising a side-planer, a turret-head boring mill, a universal facing and boring machine, and a small radial drilling machine.—*Engineer*, Feb. 1st, 1901, p. 124.

—— *Wheel Lathe* v. *Boring Mill.* Description of a case in which an American machine-tool used by the Campbell Gas Engine Company, of Halifax, proved to be useless for the work in hand, and could not be remedied, while with an ordinary fly-wheel lathe, constructed by Mr. Henry Broadbent, of Sowerby Bridge, the task was easily accomplished.—*Engineer*, Feb. 8th, 1901, p. 148. (Ill.)

Milling Machine.—*Universal Milling Machine.* Description of an interesting machine constructed by Messrs. Hill, Clarke & Co., of 156, Oliver Street, Boston, and 12, South Canal Street, Chicago, U.S.A., giving the essential data of construction and general dimensions.—*Engineering*, Feb. 8th, 1901, p. 172. (Ill.)

7. Refrigeration and Cold Storage.

Refrigeration.—*Artificial Production of Cold.* Abstracts from lectures delivered by Dr. W. Hampson at University College, London. The first instalment deals with the theory of heat and the historical evolution of this theory.—*Cold Storage*, Feb. 15th, 1901, pp. 383, 384.

Refrigerating Machines.—*The Cheapest Refrigerating Installation in the World.* Until recently small dealers had to be satisfied with the old-fashioned ice-boxes and ice-chambers, as refrigerating machinery was far too expensive when used on a small scale. Recently, however, Messrs. William Douglas & Sons, Ltd., of Putney, London, S.W., have placed upon the market a combination of cooling appliances which is both efficient and cheap. The refrigerating machinery and small cold room combined will be delivered, fitted, and started, by the makers, anywhere in the United Kingdom for the sum of £100, while as regards the motive-power, they supply a special gas engine at the price of £42 10s., so that the total installation costs £142 10s. The article describes the construction and working of the plant.—*Ice and Cold Storage*, Feb., 1901, pp. 46-48.

—— *General Principles of the Refrigerating Machine.* By Mr. Hall Williams, A.M.I Mech.E., A.M.I.E.E. Abstract of a lecture delivered by the author before the City of London College Science Society.—*Cold Storage*, Feb. 15th, 1901, pp. 378-383.

8. Miscellaneous.

Machinery.—*Paper Making Machinery at the Paris Exhibition.* Description of the exhibits of a small number of paper manufacturers, illustrating the great progress made in paper-making machinery during the last ten years. Only such machines are described as could be seen in actual working.—*Engineering*, Jan. 18th, 1901, pp. 74, 75. (Ill.)

Machinery Exhibition. *Glasgow International Exhibition. No. I. The Machinery Section.* The article, after giving in the introduction a general idea of the prospects of this exhibition, which will be several times larger, as regards buildings and outside ground, than even the very successful Glasgow Exhibition of 1888, and pointing out that the main buildings are practically complete, gives a more detailed account of the Machinery Hall, erected, together with the Industrial Hall, by the Arrol Bridge and Roof Company.—*Engineering*, Feb. 23rd, 1901, pp. 185-187. (Ill.)

MINING AND METALLURGY.

1. Coal and Coke.

Coal Mines.—*Norton Coal Mines.* This is a description of the mines, the coal seams, and the methods of mining and hauling the coal in the Norton Coal Mines, Norton, Virginia, U.S.A., situated at the terminus of the Clinch Valley Division of the Norfolk and Western Railway, which is also the terminus of the Cumberland Valley Division of the Louisville and Nastville Railroad.—*Mines and Minerals*, Feb. 1901, pp. 289, 290. (Ill.)

2. Copper.

Copper Smelters.—*The British Columbia Company's Smelting Works at Greenwood, B.C.* Description of an interesting smelting plant erected in 1899-1900, by Paul Johnson, with the object of treating the company's ores and also those of adjoining districts. The article contains a full description of the equipment of the smelters, and of the working methods employed.—*Engineering and Mining Journal*, Feb. 16th, 1901, pp. 232-4. (Ill.)

3. Gold and Silver.

Gold Mining.—*The Gold Coin Mine.* This is a historical sketch of the development, and a description of the shafts, the interior and the surface plant of one of the famous Cripple Creek mines, which is owned by the Woods Investment Company, distinguished by its enterprise throughout the district. The Gold Coin Mine had a humble beginning, but soon grew to be a very important mine, and a magnificent plant was built for it. Soon after completion it was burnt; but far from depressing the owners, the unfortunate accident merely stimulated them to new enterprise, and the new plant is built on a yet more extensive scale.—*Mines and Minerals*, Feb., 1901, pp. 291-93. (Ill.)

4. Iron and Steel.

Annealing.—*The Annealing of White Cast Iron.* By Charles James. Abstract of a paper read before the Franklin Institute, Philadelphia, in which the author treats the subject on the basis of results obtained not in the laboratory but in daily business practice during a considerable period of time.—*Foundry*, Feb., 1901, pp. 270, 271.

Iron Mining.—*Lake Superior Output.* Editorial on the importance of the meeting of the Lake Superior Bessemer Ore Association during the last week in January, convened to fix the price of ore during the present year, and an account of the output of the above-named ores, which exceeded all previous years and established another record.—*Engineering*, Jan. 25th, 1901, p. 119.

MUNICIPAL ENGINEERING.

1. Gas Supply.

Carbonising Process.—*Professor Lewes's Latest Patent.* This contribution contains a full summary of the specifications of a patent granted to Professor Lewes for an improvement in the modern carbonising process by which a very important saving in cost and increase in efficiency is to be effected.—*Journal of Gas Lighting, etc.*, March 26th, 1901, p. 820.

Conveying Plant.—*New Hot-Coke Conveying Plant at the Leeds Gas Works.* Description of a system of coke conveying which has been laid down at the Meadow Lane Station of the Leeds Gas Works, and known as the Graham Patent Hot-Coke Conveyer (the patents being in the name of Maurice Graham), and was constructed and erected by Messrs. Graham, Morton and Co., Ltd., of Leeds.—*Journal of Gas Lighting, etc.*, March 19th, 1901, pp. 753-55. (Ill.)

Gas Burners.—*Keith's High-Pressure Gas Burner and Automatic Lighter.* Description of a burner which, though not perhaps superior to those of other types, is thoroughly efficient and original in many points, and of an automatic lighter for high-pressure burners, constructed with the object of utilising it for the simultaneous lighting of whole series of burners from the point where the compressers are situated, or for lighting and extinguishing burners in inaccessible situations by simply putting the compressers into or out of use.—*Journal of Gas Lighting, etc.*, March 12th, 1901, pp. 682, 683. (Ill.)

Gas Manufacture.—*New Retort House at Dorking Gas Works.* Description of recent extensions made in the plant of the Dorking Gas Company, comprising a new retort house, furnished with regenerative settings and coal elevating and conveying machinery, designed for the production of 500,000 cubic feet of gas per day.—*Journal of Gas Lighting, etc.*, Feb. 26th, 1901, p. 541.

—— *Valuation of Gas Liquor.* By F. J. R. Carulla. This is a paper read before the Nottingham section of the Society of Chemical Industry, in which the author dwells on the dissatisfaction caused by the sale and purchase system generally adopted, and on various other points of interest regarding the disposal and acquisition of gas liquor. He also describes a modified distillation test for ammoniacal liquor adopted by the Bristol Gas Company.—*Journal of Gas Lighting, etc.*, Feb. 26th, 1901, pp. 542, 543.

—— *Technical Instruction in Gas Making in Germany.* This is the translation of parts of the report drawn up by the committee appointed some time ago by the German Gas Association to inquire into the above subject. The object was the ascertaining of the most efficient methods of training of foremen, managers, and lighting engineers respectively.—*Gas World*, Feb. 2nd, 1901, pp. 164-66.

Naphthaline.—*Naphthaline Remedies.* Translation of contributions to the *Zeitschrift für Gas Beleuchtung* on the Naphthaline question.—*Journal of Gas Lighting, etc.*, March 19th, 1901, pp. 756, 757. (Ill.)

2. Sewerage.

Sewage Treatment.—*Bacterial Treatment of Crude Sewage.* This is the Third Report to the Main Drainage Committee of the London County Council by Dr. Clowes and Dr. Houston. The first portion refers to the chemical and general aspect of the sewage question, the primary and secondary treatment in beds of Kentish

ragstone and coke 5 ft. in depth, as represented in the experimental bacterial treatment of crude sewage at the northern outfall works at Barking.—*Public Health Engineer*, Feb. 23rd, pp. 160-61; March 2nd, pp. 179, 180; March 9th, p. 200; and March 30th, pp. 265, 266. (To be continued.)

3. Streets and Pavements.

Rolling of Roads.—*Steam Rolling.* By Stephen Harding Terry, M.Inst.C.E. The author strongly emphasises the value of steam-rollers, and expresses the opinion that the time is near when every country road must be made by steam-rollers, and ought to be kept in perfect condition on scientific principles. He shows by an example we were fully alive to the value of steam-rollers as long as 24 years ago, and remarks that, by the use of such rollers on country roads, the country would save millions a year in road repairing, while the saving of wear and tear to vehicles, horses, etc., would amount to probably four times that sum.—*Public Health Engineer*, March 23rd, 1901, pp. 238, 239.

Street Traffic.—*Streets and Street Traffic.* This is a reprint of the Report of the General Purposes Committee of the London County Council, dealing with refuse removal, the collection of refuse, dustbins, avoidable litter, cleaning of streets and footpaths, watering, etc., removal of snow, building operations, vehicular traffic, opening up of roads and streets, unoccupied land, and places of convenience.—*Public Health Engineer*, March 9th, 1901, pp. 201, 202.

4. Water Supply.

Water Supply.—*The Metropolitan Water Supply.* Abstract of the Report on the condition of the Metropolitan Water Supply during November, 1900, by the water examiner appointed under the Metropolis Water Act, 1871.—*Public Health Engineer*, March 9th, 1901, p. 200.

NAVAL AND MILITARY ENGINEERING.

1. War Vessels.

Submarine Boats.—*The "Holland" Submarine Boat.* This is a description taken from a letter published in the *Scotsman* of the Holland Submarine Boat, which has been adopted by the Royal Navy and considered to be the most efficient and practical reversible vessels ever built.—*Steamship*, April, 1901, p. 383.

Torpedoes.—*Torpedo Craft (United States and Foreign) Types in Employment.* By Lieut. R. H. Jackson, U.S.N. In the present instalment of the prize-essay of the author, read before the U.S. Naval Institute at Annapolis, the theme of an attack upon a superior is discussed, which is followed by a criticism of certain points of equipment, some features of steam engineering, and finally the distribution of service in time of peace.—*Marine Engineering*, March, 1901, pp. 99-102.

Warships.—*Launch of four Warships for the British Navy.* This is a short account of the launching of the *Albemarle* from Chatham, the cruiser *Drake* from Pembroke, and the *Montagu* from Devonport on March 5th, and of the first-class cruiser *Kent* from Portsmouth on March 6th.—*Steamship*, April, 1901, p. 384.

2. Equipment.

Machinery.—*Machinery for the New U.S. Battleships and Armoured Cruisers.* The article deals with the designs for the engines of the new battleships of the *Georgia* class, the auxiliary machinery, the steam pipes, the electric plants for the three battleships, and the machinery for the cruisers. The names of the battleships referred to are *Georgia, New Jersey, Pennsylvania, Rhode Island*, and *Virginia*; the armoured cruisers are named *California, Colorado, Maryland, Nebraska, South Dakota* and *West Virginia.*—*Marine Engineering*, Feb. 1901, pp. 53-59. (Ill.)

3. Armour Plates, Guns and Ammunition.

Field Artillery.—*Recent Changes in German Field Artillery Material.* By Major W. A. Macbean, R.F.A. The author points out that Germany, although having long hesitated to adopt a special piece of artillery suitable for attacking and defending fortified places (that promise to play an important part in the warfare of the future) once she realised that the change was necessary, swiftly and with characteristic thoroughness armed the whole of her field artillery with a proportion of howitzers, and made other changes in organisation and gunnery regulations that mark an epoch in the history of her artillery. The author describes the new piece of artillery and the ammunition used, and gives an account of the new regulations.—*Proceedings of the Royal Artillery Institution*, Feb. 1901, pp. 571-7.

4. Miscellaneous.

Dockyards.—*Equipment and Methods of the Indian Dockyards.* This is an interesting sketch, consisting of a concise description of the plant and the work performed at the Government dockyards in India, notably that of Bombay, in which the author, Mr. A. C. Bowden, gives due credit to the efficient condition in which these dockyards are kept and to the admirable adaptation of the arrangements to the peculiar characteristics of Indian life and native labour.—*Engineering Magazine*, March, 1901, pp. 1001-12. (Ill.)

Field-Glasses.—*Field-Glasses for Service.* By Major G. Osborn, R.A. The author points out that the experiences of the South African war have demonstrated the necessity of good field-glasses, since the use of smokeless powder leaves the field clear and the long range of firing makes it difficult to locate an enemy; and, since a bullet at present travels quicker than sound, the whistle of the bullet or the sting indicating that it has actually struck being the first indication of an enemy in front, it is of great importance to espy by sight the place where he is stationed. He then discusses the various kinds of glasses and their special adaptation to special conditions.—*Proceedings of the Royal Artillery Institution*, Dec. 1900, pp. 485-93.

Russian Navy.—*The Russian Volunteer Fleet.* By a Staff Correspondent. This is an interesting account of a unique institution of Russia, namely, its volunteer fleet, which, as the author says, has played no small, if inconspicuous, part in the recent stirring events that have taken place on the Pacific border of the Celestial Empire. This fleet receives an annual subsidy of 600,000 roubles, on condition of a certified number of vessels being built within a given period, and the fees paid for passing the Suez Canal are refunded by the State Audit.—*Cassier's Magazine*, April, 1901, pp. 719-29. (Ill.)

Weapons and their use.—*The Practical Use of Weapons.* By Major G. N. Nicholson, D.I. of M. Cork District. The author gives his reasons for holding the opinion that the instructions recently issued by the Adjutant-General, abolishing the show movements of the bayonet, manual and firing exercises on battalion parades, form an epoch in the history of the army, and a new step in the right direction; he repudiates the idea that their abolition jeopardises discipline and steadiness.—*United Service Magazine*, February, 1901, pp. 491-94.

RAILWAY WORK.

1. Motive Power and Equipment.

Bogies.—*Underframe and Bogies for 1st and 2nd Class Composite Carriages: South-Eastern and Chatham Railway.* Drawings of the above underframes and bogies, designed by Mr. Harry S. Wainwright, locomotive, carriage, and wagon superintendent of the South-Eastern and Chatham Railway, illustrated in the January issue of the same journal.—*Railway Engineer*, March, 1901, p. 83.

Freight Cars.—70,000 *lb. Capacity Flat Car, Northern Pacific Railroad.* Description of a freight car as above mentioned, 41 ft. in length, of which

a lot of 800 has recently been ordered from the American Foundry Company.—*Railway Master Mechanic*, March, 1901, pp. 172-4.

Heating Feed Water.—*Heating Feed Water with Air Pump Exhaust.* Summary of a discussion on the subject at the North-West Railway Club, U.S.A., from which it appears, to judge from the consensus of opinion, that the system possesses economies that fully justify its use.—*Railway and Locomotive Engineering*, Feb. 1901, p. 79.

Locomotive Boilers.—*The Vanderbilt Boiler.* This is a digest of a paper read by Mr. Cornelius Vanderbilt at the Junior Club of the American Society of Mechanical Engineers, in which the young multi-millionaire, who seems to have always had an inclination for engineering pursuits, describes a boiler patented by him some years ago, in which a single large corrugated tube takes the place of the rectangular fire-box, and forms a locomotive furnace. An engine equipped with this boiler was built by the New York Central, and put to work hauling freight in August, 1899, and has been in service ever since, it is said.—*Railway and Locomotive Engineering*, Feb. 1901, pp. 57, 58.

—— *New Locomotive Boiler.* Description of a new style of locomotive boiler, invented by a Pittsburg (Pen., U.S.A.) inventor, which, although built after the "Belpaire" type, has numerous peculiarities that are radical innovations, among them perpendicular tubes, with openings above fire, which are to connect with larger horizontal tubes running through the barrel to the smoke-box. The inventor appears to expect great things from his novel boiler.—*Railway and Locomotive Engineering*, March, 1901, p. 105.

Locomotives.—*Two New Shenectady Locomotives.* Description of two of the latest locomotives turned out by the Shenectady Locomotive Works, one of them being a compound consolidation engine, built for the New York Central and Hudson River Railway, weighing 190,000 lbs., the other being a six-coupled switch engine for the Colorado Springs and Cripple Creek District Railway, weighing 133,000 lbs.—*Railway Master Mechanic*, March, 1901, p. 69. (Ill.)

—— *German Four-cylinder Compound.* The article deals with a locomotive of the above description, exhibited by the Hanover Construction Company, Germany, at the late Paris Exhibition, where it attracted a great deal of attention on account of its handsome appearance. It contains a number of novel features, notably a valve gear, patented by Mr. von Borries, of Hanover, a German railway expert.—*Railway and Locomotive Engineering*, March, 1901, pp. 120-22.

Baldwin Locomotives.—*Baldwin Atlantic Types for Germany.* Description of a locomotive recently built at the Baldwin Works in the United States for the State railways of Bavaria.—*Railway and Locomotive Engineering*, Feb., 1901, p. 62.

Ore Cars.—*New 100,000 lb. Capacity Wooden Ore Cars—Chicago, Milwaukee, and St. Paul Ry.* Comments on ore-cars of the above capacity, of which 250 have been running since last summer on the lines of the railroad mentioned, and of whose strength some idea may be given by stating that there is practically no deflection of the sills under a load of 112,000 lbs.—*Railroad Gazette*, March 1st, 1901, p. 141. (Ill.)

Passenger Engines.—*Express Passenger Engines, Madras Railway.* Description of the new type of engines, built in 1899, to work the mail trains between Bombay and Madras, over the Madras section of the journey.—*Railway Engineer*, March, pp. 69, 70. (Ill.)

Railway Cars.—*Passenger Cars for New Zealand.* Concise description of a class of cars built by the American Car and Foundry Company, just finished at their Jeffersonville shops, and ordered by the New Zealand Government Railway, which are taken to pieces and boxed, so as to render their shipment to their destination easy. They are 42 ft. 7 in. long on the end sills, with a platform on each end 2 ft. 6½ in. long, which makes their total length 47 ft. 8 in., and have seats for 30 passengers in all. The novel feature in them is the arrangement for boxing them for shipment, which consists in making the roof and each side of two pieces.—*Railway and Locomotive Engineering*, February, 1901, p. 60.

Tool Car.—*A Pneumatic Tool Car.* Description of a portable pneumatic tool plant, which is likely to find a very wide application, designed and fitted up by Mr. W. N. Finley, principal assistant engineer of the Chicago and North-Western Ry.—*Railway Master Mechanic*, March, 1901, p. 70.

2. New Projects and Lines in Construction.

New Railways.—*New Spanish Railways.* The writer points out that efforts are being made in Spain to reduce the prevailing high cost of coal by developing the native mines, and gives a few details regarding a projected new railway line to be built from Saragossa to Utrillas, which will have a length of 77 miles, and serve the purpose of securing transport to the output of the well-known collieries in the province of Teruel.—*Railway and Locomotive Engineering*, March, 1901, pp. 138, 139.

3. Permanent Way and Fixtures.

Block Signals.—*Single Track Automatic Block Signals on the Southern Pacific.* Description of block signals which the above railway is putting up on 30 miles of its line, single track, on the San Joaquin division, in the Tehachapi Mountains in Southern California.—*Railroad Gazette*, March 8th, 1901, p. 163.

Car Shops.—*Redville Car Shops—New York, New-haven, and Hartford.* Description of an establishment of car repairing shops at Redville, Mass., under construction for the above-named railway, which, when completed, will probably be the most extensive plant of the kind in the United States, for it will have a capacity for repairing 120 passenger and 1,000 freight cars per month.—*Railroad Gazette*, Feb. 15th, 1901, p. 107. (Ill.)

Railway Bridges.—*The North-Western's Des Moines River Bridge.* This is a short account of a work of considerable magnitude undertaken by the above-named railway, in connection with its Boone-Ogden cut-off in Iowa, since the structure is 185 ft. in height above the river, has a length of 2,685 ft., of which the span over the river consumes 300 ft., and a width of 19½ ft., with a deck about 30 ft. in width for double track. The cost of the steel-work alone was 450,000 dols., and that of the sub-structure about 150,000 dols.—*Railway Age*, March 8th, 1901, p. 179.

Round Houses.—*Round House Design.* Digest of the answers sent in reply to a circular issued by the Master Mechanics' Committee to elicit replies to the question: "What should be the arrangements and accessories of an up-to-date round-house?"—*Railway Master Mechanic*, March, 1901, pp. 80, 81.

Sleepers.—*Combined Iron and Wood Sleeper.* This is a short account of a sleeper of the above description now under trial on the North-Western S.R. of India, said to possess many advantages over steel, cast-iron, pot and wood sleepers.—*Railway Engineer*, March, 1901, p. 69. (Ill.)

Steel Rails.—*Finishing Temperatures for Steel Rails.*—Abstract of a paper by Mr. Robert W. Hunt, read at the Richmond meeting of the American Institute of Mining Engineers, in which the author dwells on the importance of the physical treatment of steel during its manufacture into rails, and describes some very interesting experiments and their results.—*Railway Gazette*, Feb. 22nd, 1901, pp. 124, 125.

Tunnels.—*Ventilation of the East Mahanoy Tunnel—Philadelphia and Reading.* By Theodore Vortrees, C.E., first Vice-President. The tunnel referred to is situated 2·2 miles east of Mahanoy City, and was built in 1861, and has a length of 3,406 ft., running almost exactly in a north-westerly and south-easterly direction; the traffic has always been heavy, notably so within the past four years, and is likely to increase. Owing to the prevalence of north-west winds and the situation of the north portal, the air has been frequently very foul and unsafe for the crews of slow-moving trains. An efficient ventilation plant became necessary, and the construction of such a plant, carried out by the Philadelphia and Reading Coal and Iron Company, and working satisfactorily since June 1st last year, forms the subject matter of this article.—*Railroad Gazette*, March 8th, 1901, pp. 154, 155. (Ill.)

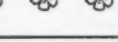
REVIEWS.

"Traction and Transmission": A Monthly Supplement to "Engineering."—Under this title a new contemporary made its appearance last month among us, and, having as its chaperon the excellent periodical whose "supplement" it is to be, was received by us naturally with expectation. This sentiment we found on opening its pages to be fully justified, though for some time at least that of perplexity predominated. For whom, we asked ourselves, is intended this gigantic type, this substantial paper, and, above all, this didactic style, reminding us of our school days, when a kindly teacher left no means untried of placing within the grasp of even the slowest among our comrades those facts of science with which he intended to enrich our knowledge. His predecessor had revelled in presenting us with a quantity of information that, explained in the ordinary way, would have required weeks instead of days to be dealt with, but in the concise terms of mathematical formulas which he used could be grasped quickly and without difficulty by all—but there lies the crux—who were endowed with the mathematical faculty. For a small percentage of us his system was admirably suited, but for the bulk it meant nothing. His humane successor felt sympathy for "the many"; he abandoned mathematics altogether, and the moment the hated symbols had disappeared "the many" began to breathe again. The editor and writers of *Traction and Transmission* seem to have followed the same plan. They speak on weighty matters in ordinary language, and do not mind explanations, however lengthy, if such render the subject clear to even those to whom it is new. Is their paper intended to be a friend of the young? To judge from the text this might be the case, but the type in which it is printed contradicts this supposition. It is obviously intended for eyes no longer strong, and for which that of the ordinary books or papers proves to be a sore trial. It must be, therefore, that *Traction and Transmission* is meant for "the old folk at home." There can be no doubt this newest of our electrical periodicals is intended to render accessible to the aged, to the *laudatores temporis acti*, the wonderful scientific progress of modern times, and to convince them that we are not degenerating. Or can it be, after all, that we are on a false scent? Is this new guest among us, instead of wishing to make friends of the survivors of a less wonderful era, and trying to enlighten them, bent on a crusade among the less advanced in age, but equally behind in modern knowledge? Is it sent into the world in order to appeal to influential municipal councillors who have finally made up their minds to go to school again, and to be coached, so that their remarks may make a fair show in the reports of council meetings? If so, the publishers of *Traction and Transmission* are less generous than we believed them at first to be, but certainly not less to be admired, and we wish them the fullest success in their enterprise.

BOOKS RECEIVED.

Twentieth Century Inventions, a Forecast, by George Sutherland, M.A., Longman & Co., 4/6 net; Engineering Estimates and Cost Accounts, by Francis C. Burton, The Technical Publishing Co., Ltd., 3/- net.; Sekon's Dictionary of Railway Words and Phrases, by G. A. Sekon, The Railway Publishing Co., Ltd., 1/- net.; Railway Runs in Three Continents, by J. T. Burton-Alexander, Elliot Stock.

Erratum.—Page 339 in our March issue says: "Figs. 1 to 4 show the method of driving by three-phase motors, which has been adopted by the Oerlikon Works, Zurich." This should have read: "Figs. 1 and 2, by the Oerlikon Co., and Figs. 3 and 4, by Brown, Boveri & Co., of Baden, Switzerland." It may be also mentioned that the twisting frames shown in Fig. 6 are driven by Brown-Boveri motors, and the installations given in Table III. were all carried out by the same firm.



THE Editor will be pleased to receive contributions from Engineers and others relating to progress in Civil, Mechanical, Electrical, Sanitary or Marine Engineering, Shipbuilding, Mining, Railway and Road Traction, Telegraphy and Telephony, etc., etc., for insertion under the heading of Industrial Progress.

Manufacturers and Engineers having new inventions, machines, processes, etc., which they desire to be brought before the notice of readers of FEILDEN'S MAGAZINE, are invited to send full particulars to the Editor, who will publish them free of all cost to the contributor, if they come within the purview of the Magazine. High-class engravings from photographs and drawings will be prepared free of cost to the writer.